Compres

NOVEMBER 1952

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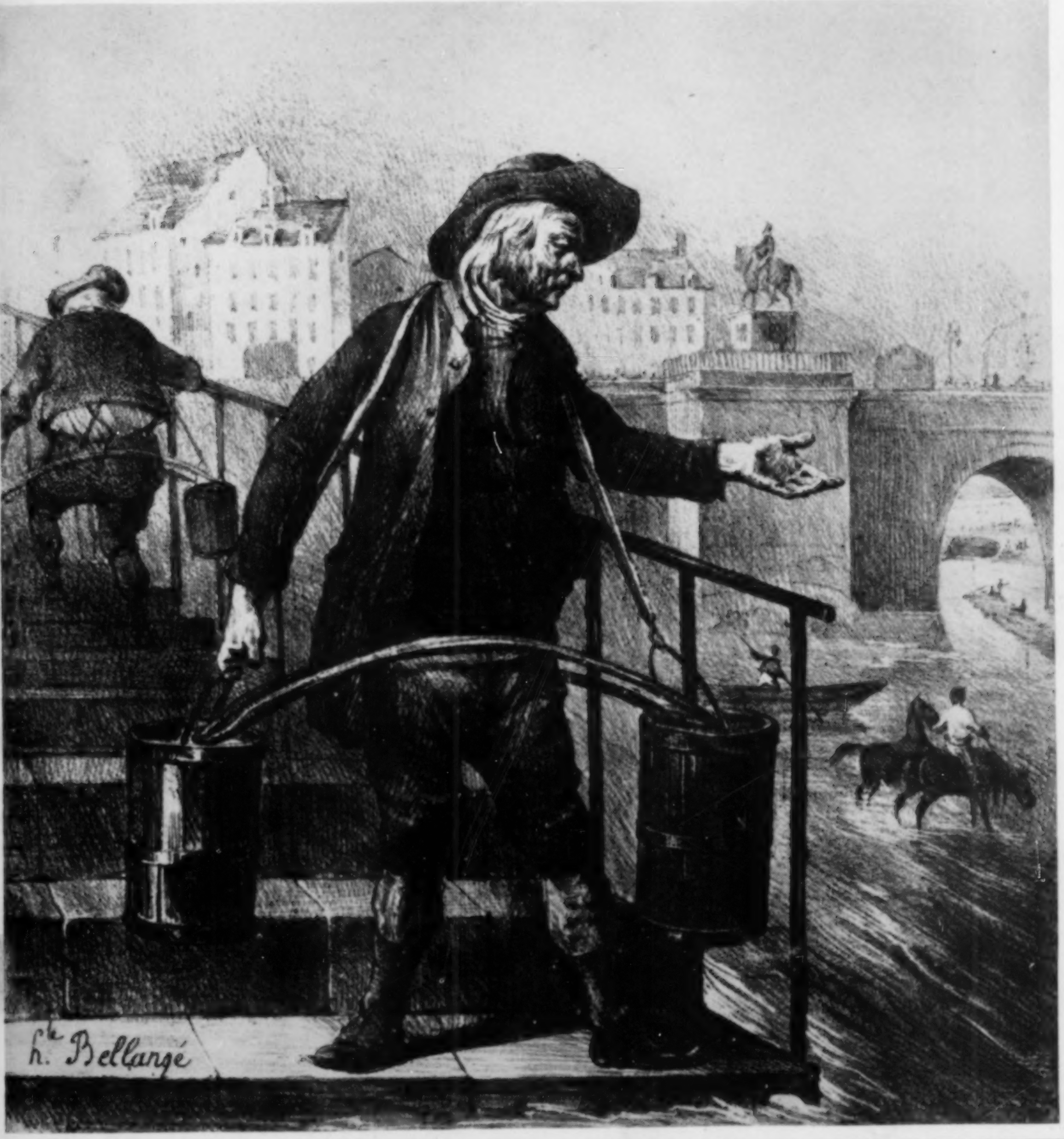


WATER SELLER
OF OLD PARIS

Purveyor of vital fluid
on way to Seine to
fill his buckets

VOLUME 57 • NUMBER 11 NEW YORK • LONDON

IT ALL BEGAN IN '33

another important story about

4-CYCLE V-ANGLE COMPRESSORS

Repeated installations of Ingersoll-Rand Gas-Engine Driven Compressors keep pace with steady growth of Lloyd Corporation, Ltd. of California Gas Booster plant

When Lloyd Corporation, Ltd. back in '42, built its booster plant in Ventura, Cal., it selected a 300-hp Ingersoll-Rand XVG compressor for gas-lift service. The XVG had revolutionized oilfield practices when it was introduced in 1933 as the first V-angle gas-engine-driven compressor, and had quickly achieved world fame and acclaim for its outstanding performance in all kinds of services.

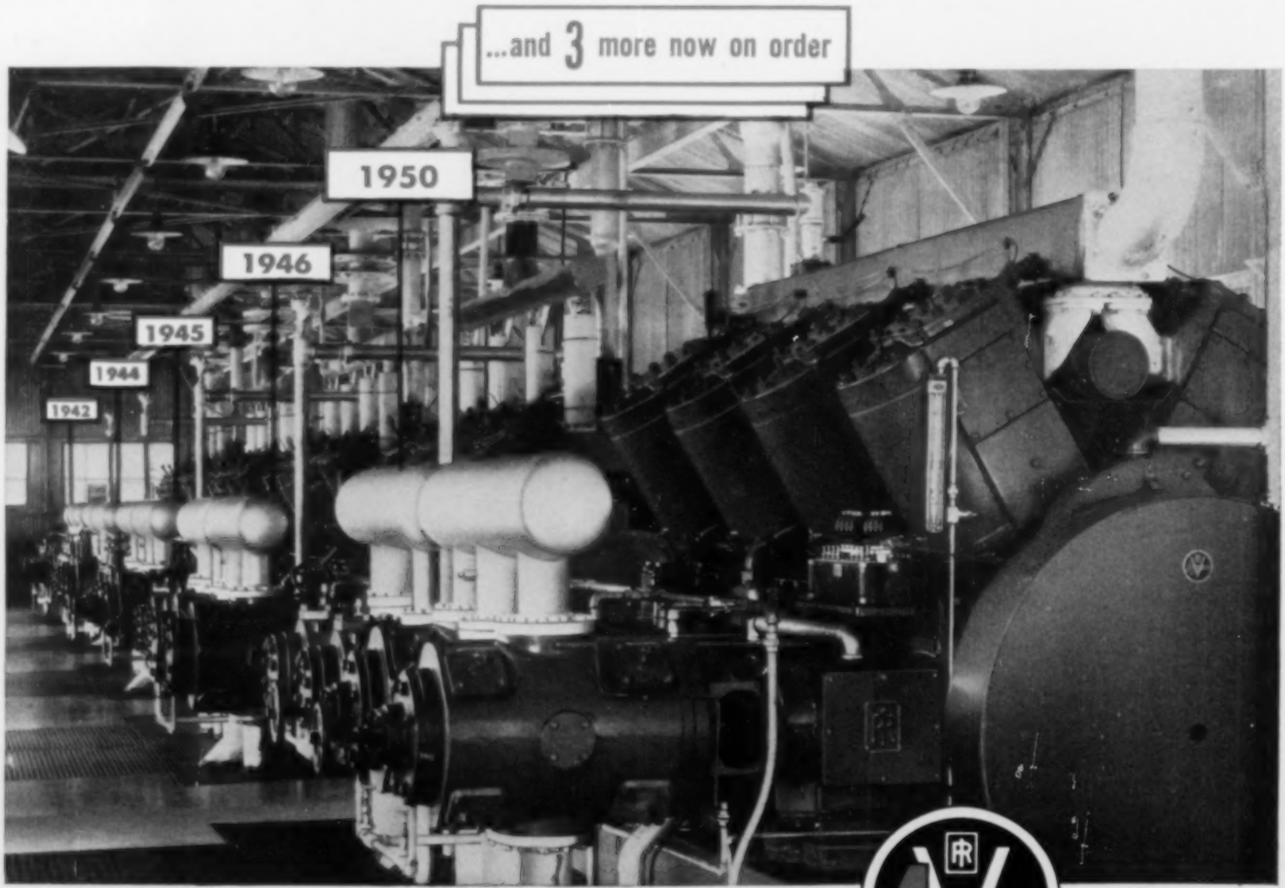
After two years' first-hand experience with its XVG, Lloyd installed another one . . . and additional units in '45 and '46.

Then in 1950 it purchased a different compressor. This machine was also an Ingersoll-Rand, and fit into the same amount of space . . . had the same number of cylinders. And it had all of the important, proven, and desirable features of the XVG.

But it had 45% more capacity. It incorporated many new and advanced design features that make it an even better machine. This was the modern design of the famous XVG. It is known as the SVG . . . made in three sizes, 330, 440 and 550 horsepower.

Lloyd liked the SVG, too. They ordered three more, two for '52 and one for delivery in early '53.

Let your I-R representative tell you more about the SVG and the other units in the full line of Ingersoll-Rand 4-cycle gas engines and compressors.

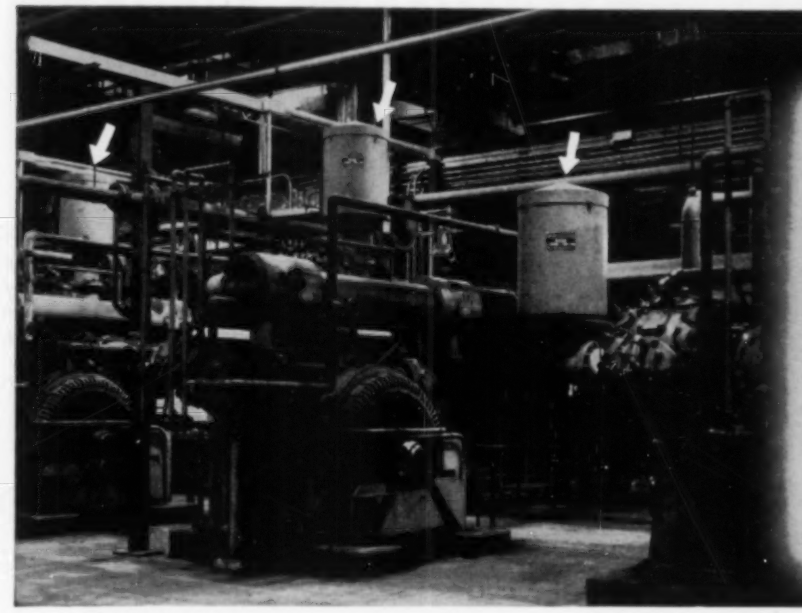


Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y. 840-6

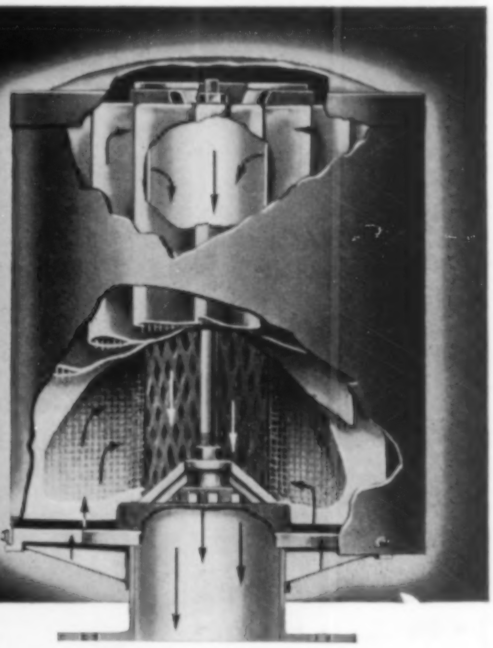
4-CYCLE

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

STAYNEW INTAKE FILTERS



Staynew Intake Air Filters of Detroit Edison Company, Detroit, Michigan protect the vital parts of these Compressors.



MODEL D Intake Filter

KEEP COMPRESSORS YOUNG!

Your air compressing equipment demands the protection Staynew Intake Filters are designed to give. With Staynew, compressors, and internal combustion engines, blowers, motors and generators remain at peak efficiency years longer.

Staynew's "Positive Protection" keeps shutdowns and repairs at an absolute minimum. And Staynew itself requires less attention. The *dry-type* filtering medium has the ability to remove air-borne dust particles without the necessity of viscous filter aids.

Staynew Intake Filters efficiently protect vital engine parts without carefully held maintenance schedules. And where noise is a problem, Model DS Silencer Filters are available. To keep equipment young, always specify Staynew.

Write today for Staynew Catalog S.I.F.

Representatives in Principal Cities

- Positive Protection
- Efficiency Actually Increases with Use
- Efficient Over a Wide Range of Loads
- Not Affected by Temperature Changes
- No Oil Carry-Over
- No Oil Blow-Out Over Free Air-Unloading Compressors

DOLLINGER
REG. PROTECTOMOTOR U.S. PAT. OFF.
STAYNEW FILTERS

DOLLINGER
CORPORATION
7 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

IN CANADA: Toronto - McCarthy & Robinson, Ltd.
Montreal - Engineering Equipment Co., Ltd.
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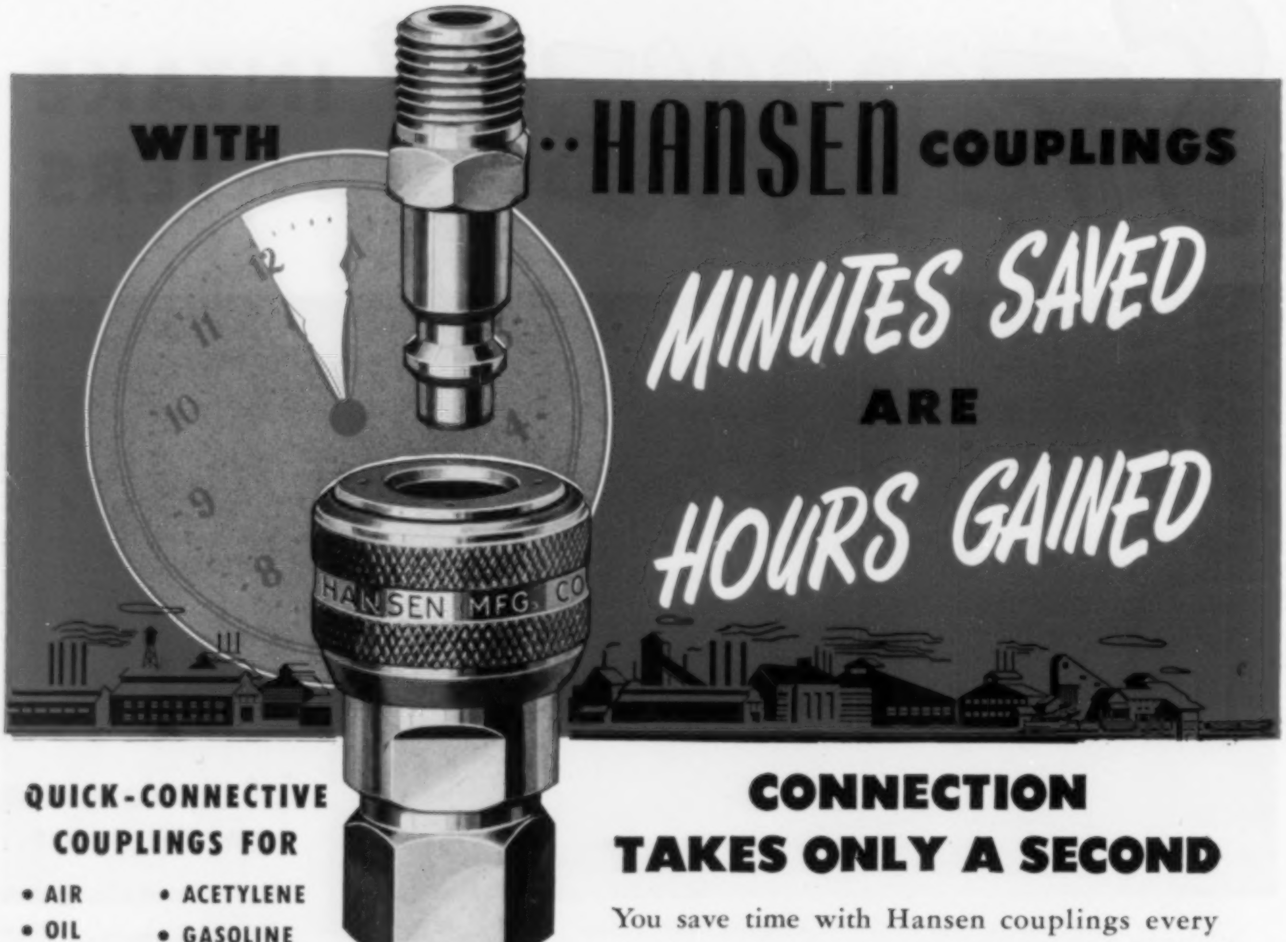

QUICK-CONNECTIVE COUPLINGS FOR

- AIR
- OIL
- GREASE
- WATER
- VACUUM
- STEAM
- OXYGEN
- ACETYLENE
- GASOLINE
- COOLANTS
- REFRIGERANTS
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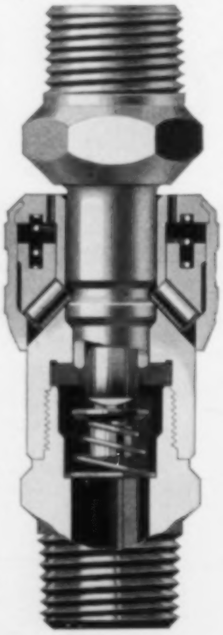
Export Department: CLEVELAND

Write for Catalog

giving descriptions and sizes of complete Hansen line of straight through and shut-off couplings for hydraulic and pneumatic connections.



CONNECTION TAKES ONLY A SECOND

You save time with Hansen couplings every time you connect or disconnect a fluid line carrying gas, liquid or grease, because Hansen couplings connect or disconnect immediately—with instant automatic flow or shut-off.

To connect, merely push plug into socket—flow starts instantly. To disconnect, pull back sleeve on socket—coupling disconnects and automatically shuts off flow.

From a wide range of available sizes and types, you can select a Hansen coupling—one-way shut-off, two-way shut-off, or straight through type—each engineered for your specific application.

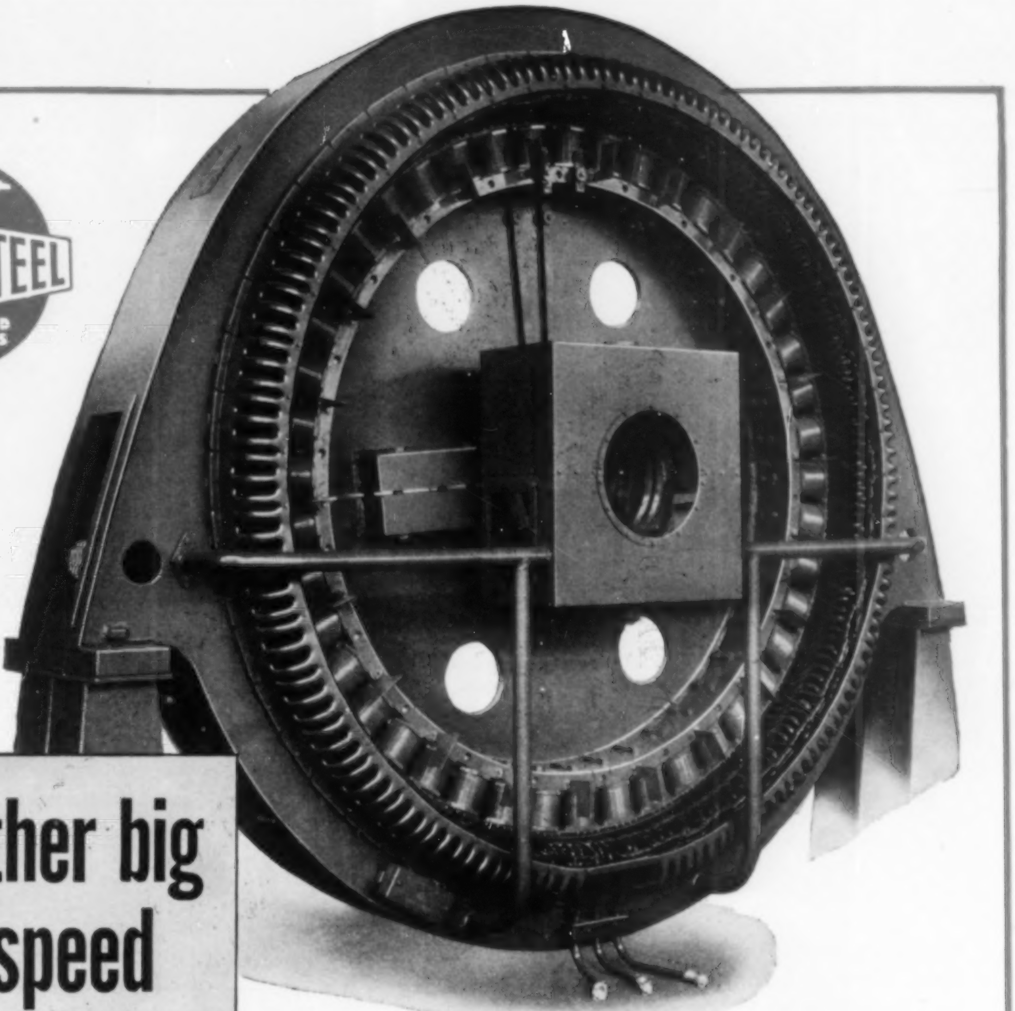
If you have any fluid lines in your plant, you can increase efficiency, save precious minutes, by the use of Hansen Couplings.

QUICK CONNECTIVE FLUID LINE COUPLINGS...

THE HANSEN MANUFACTURING COMPANY

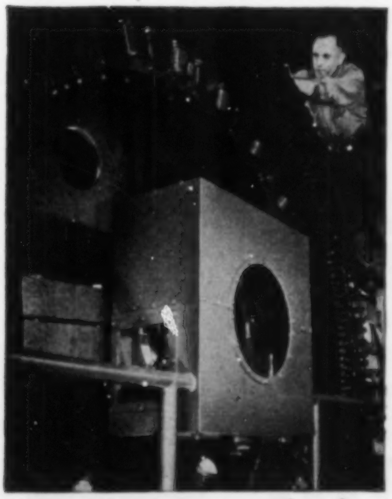
4031 WEST 150th STREET • CLEVELAND 11, OHIO

Elliott FABRI-STEEL MOTORS AND GENERATORS



Another big low-speed motor by..... ELLIOTT

A large low-speed engine type synchronous motor with split rotor, for driving Ingersoll-Rand type PRE reciprocating gas compressor.



Close-up of the pressurized explosion-resisting collector ring enclosure.

This big motor is rated 2000 hp, 164-rpm, 4000 volts, 3 phase, 60 cycle, 50 C rise, 1.0 power factor. The split rotor facilitates assembly on the compressor shaft in the field. Collector rings are enclosed, adapting the unit to duty in explosive gas atmosphere.

Elliott has established a particularly strong reputation in large motors designed for specific and individual conditions, such as the one illustrated here. An exceptional degree of rigid ruggedness is gained by the famous Elliott "Fabri-Steel" construction while high performance and endurance are assured by quality workmanship throughout.

For full details write for Synchronous Motor Bulletin PB5000-1.

R2-2

ELLIOTT COMPANY
Ridgway Division Ridgway, Pa.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

Stopers at Iron King use 1-in. quarter-octagon alloy hollow drill steel. Much of the mining here is done by cut-and-fill stoping. Lead and zinc are the principal metals produced.

Jackhammers come in handy at Iron King for a variety of drilling work. Bits and rods are reconditioned at the mine. Nearly 1½ million tons of ore have been mined here since 1906.

Drilling the stubbornest ore in Arizona

Operating men at the Iron King mine of Shattuck Denn Mining Corporation believe the rock they drill is tougher and more abrasive than any other in the state. The ore at this property, near Humboldt, Ariz., is a cherty, fine-grained sulfide. Some of it is so stubborn that ordinary steel bits will penetrate only one inch before becoming dull.

This drifter bores 7-ft holes into tough sulfide ore with 1¼-in. round Bethlehem alloy rods and carbide insert bits.

Fortunately it's not all quite that hard to drill. But because of the difficult drilling conditions, the mine management has made extensive tests of both bits and rods. This development work led Iron King to adopt carbide insert bits on rods of Bethlehem alloy drill steel.

This combination has made possible increased production at lower cost per ton. Previously they used conventional bits on carbon drill steel rods. Bethlehem hollow drill steel is used exclusively at Iron King because, in the words of H. F. Mills, manager, "it's the best of the steels we've tried."

Opened in 1906, Iron King is principally a lead and zinc producer. Some gold and silver are also recovered from the complex sulfide ores. Production currently totals about 17,000 tons monthly on a two-shift schedule.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM HOLLOW DRILL STEEL

BETHLEHEM STEEL

Compressor cuts cost of making money

...with help of TIMKEN® bearings

INGERSOLL-RAND'S 25 horsepower Type 40 air compressor unit supplies the general air requirements in a government mint. To keep the compressor on the job and cut maintenance costs, Ingersoll-Rand mounts the crankshaft on Timken® bearings.

Timken bearings carry both radial and thrust loads in any combination, due to their tapered design. Shaft and adjacent parts are held in proper alignment. Wear is minimized.

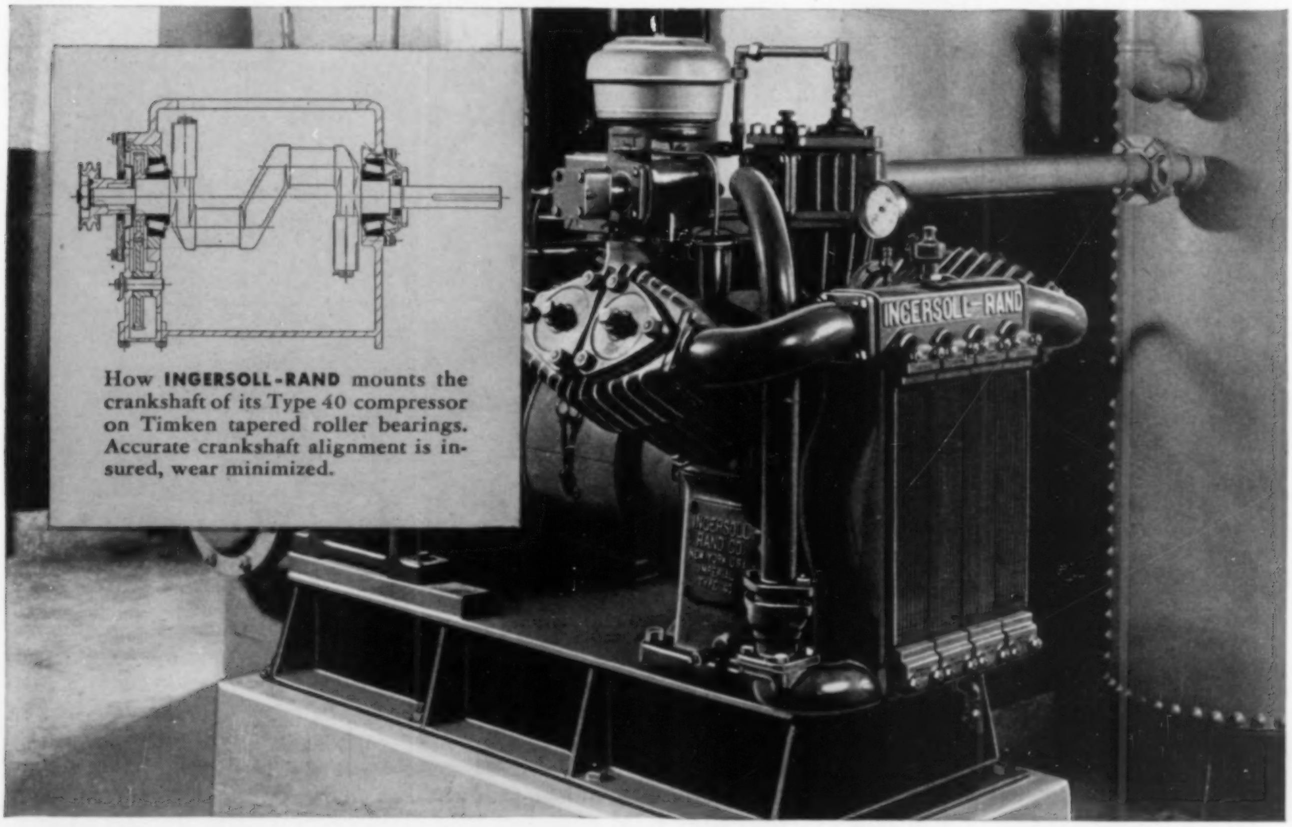
By holding shaft and housings concentric, Timken bearings make closures more effective. Dirt and moisture are kept out—lubricant kept in. Lubrication and maintenance time is reduced.

Line contact between rollers and races gives Timken bearings extra load-carrying capacity. Their incredibly smooth finish and true rolling motion practically eliminate friction.

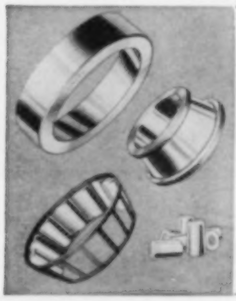
Since Timken bearings are precision made, engineered for the job and made of Timken fine alloy steel, they normally last the life of the machine.

If you want dependable low-cost operation and long life in the machines you use or make, always be sure they're equipped with Timken bearings. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address "TIMROSCO".

This symbol on a product means its bearings are the best.



How **INGERSOLL-RAND** mounts the crankshaft of its Type 40 compressor on Timken tapered roller bearings. Accurate crankshaft alignment is insured, wear minimized.



DESIGN LEADERSHIP

The first Timken tapered roller bearing was produced in 1898. Since then the one-piece multiple perforated cage, wide area contact between roller ends and ribs, and every other important tapered roller bearing improvement have been introduced by The Timken Roller Bearing Company.

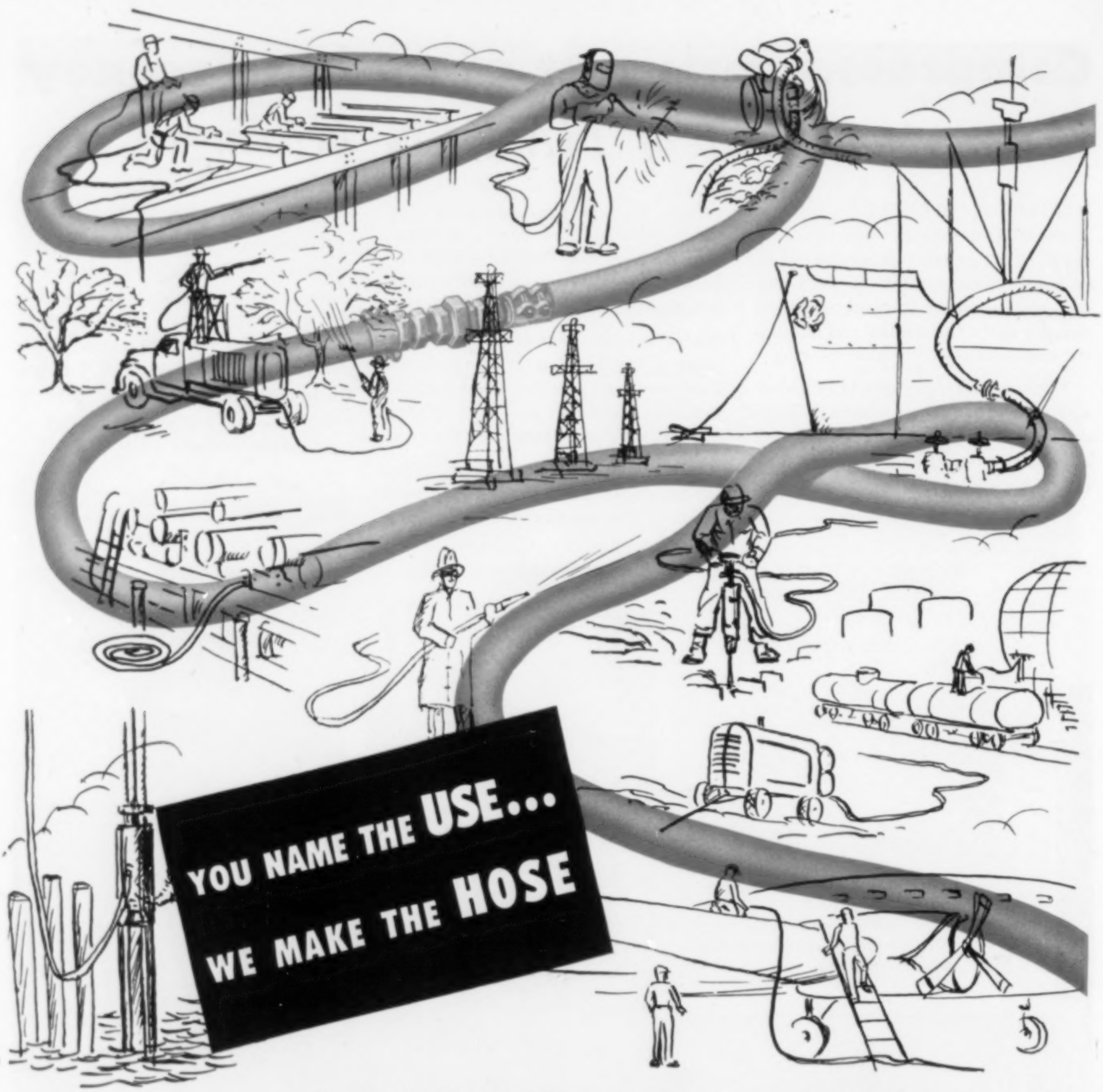
The Timken Company leads in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL AND THRUST →← LOADS OR ANY COMBINATION



Our Condor Homoflex Hose is an example . . . Raybestos-Manhattan engineers found a way to build strength into a hose-wall without simply adding weight and thickness in more plies. The result, this Hose is flexible as a rope . . . and a real labor saver wherever men must constantly work with hose. On the other hand, Raybestos-Manhattan makes the world's *largest* and *heaviest* hose for oil drilling and loading, and for suction • Hose may not be your problem today, but whenever you think of industrial rubber products . . . transmission, conveyor, V-belts, or hose . . . remember R/M engineers have developed exclusive features to give you more for your money in every use. Consult your R/M representative.

R/M

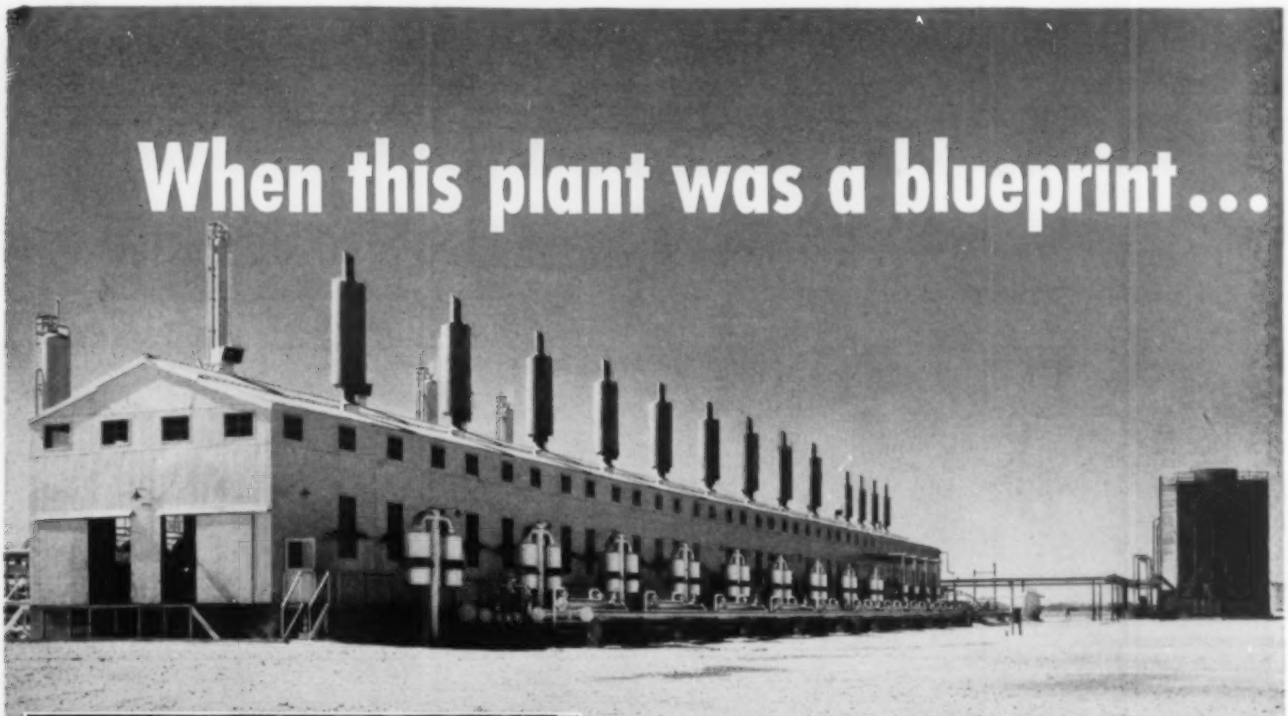
MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

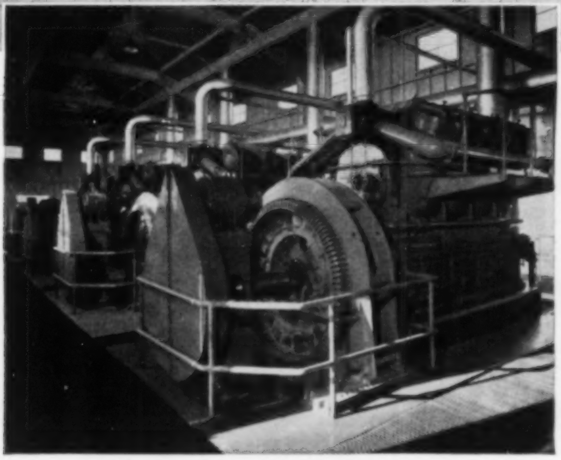
RAYBESTOS-MANHATTAN, INC.

Flat Belts · V-Belts · Conveyor Belts · Hose · Roll Covering · Tank Lining · Abrasive Wheels

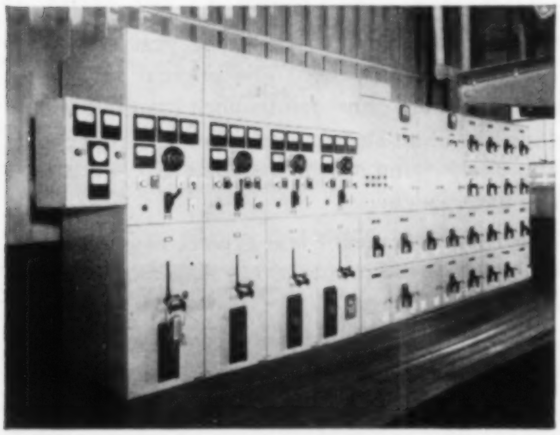
Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Packings • Brake Linings • Brake Blocks
Clutch Facings • Asbestos Textiles • Sintered Metal Parts • Bowling Balls

When this plant was a blueprint...





Four E-M Engine-Type Generators furnish power for Gulf Oil Corporation's Sand Hills plant. Casing-head gas is piped here from the field, processed for removal of natural gas, propane and butane, and distributed.



Switchboard designed by E-M for Gulf Oil Corporation includes swing panel for synchronizing equipment, four manual generator panels with panel mounted voltage regulators, and watthour meter.

... Four E-M Engine-Type Generators were designed especially for it

The story behind a modern gas processing plant such as the Gulf Oil Corporation's Sand Hills plant at Odessa, Texas (above) has many chapters. Each particular phase of this well-integrated plant was designed and planned by skilled specialists in the petroleum industry.

E-M was proud to join this task force early, to design and build four 660 KVA, 327 rpm Engine-Type Synchronous Generators and associated switchgear to provide power for this new plant.

Simplicity, efficiency and dependable low-cost service are keynotes of E-M design. The cage winding on the rotor of each generator, built especially for this application, has excellent damping characteristics to provide smooth, flickerless parallel operation.

Correct voltage regulation, designed by E-M, makes motor starting with minimum voltage dip possible. "Powerhouse" coil insulation treatment puts extra-tough outside coating on the generator coils, making them highly resistant to corrosive vapors that may be present in a gas plant.

Keep E-M in mind when you want custom-built generating equipment tailored to your own specialized needs. Ask your nearest E-M field engineer for his suggestions on how E-M Engine-Type Synchronous Generators may fit into your projected plant. Also, write the factory for Synchronizer No. 30, a special issue for the petroleum industry.

2200-TPA-2105

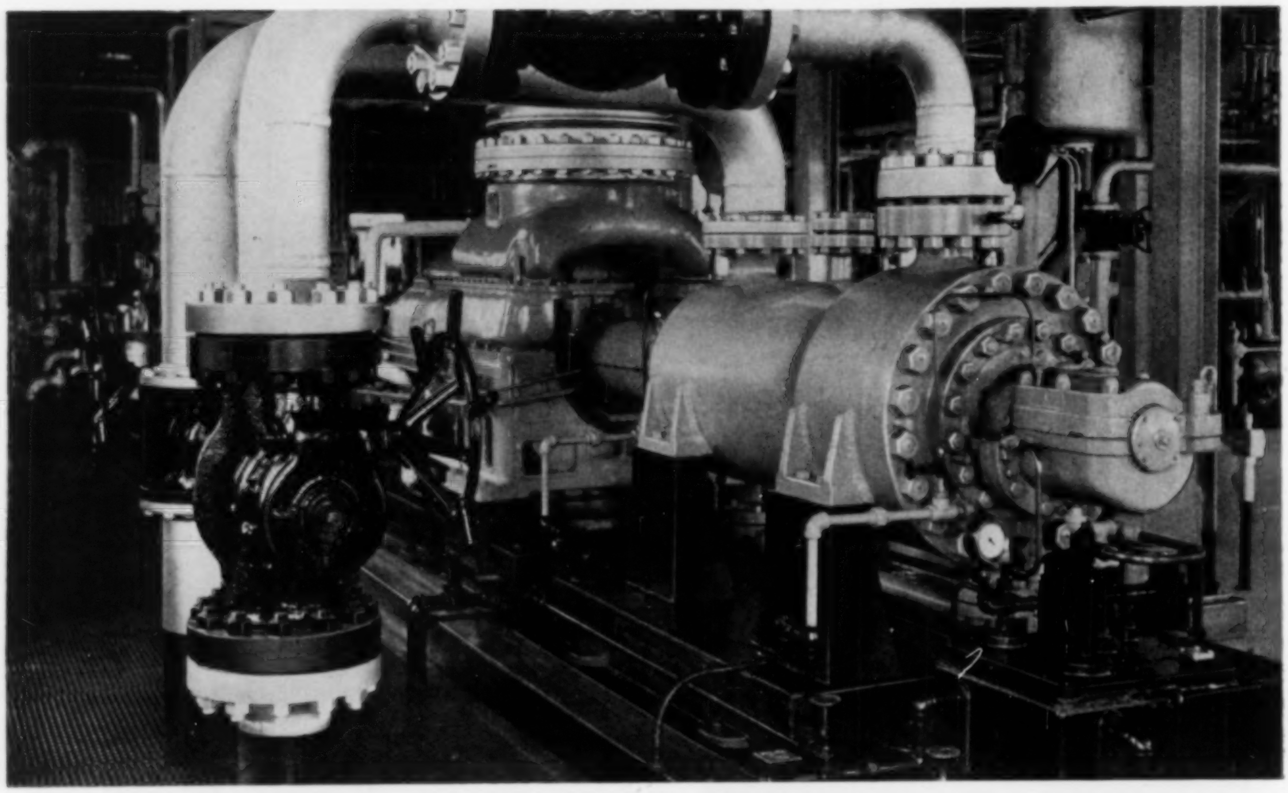
E-M

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

Ingersoll-Rand High-Pressure Pumps at the Katy Cycling Plant

SET IMPRESSIVE RECORD

of Maintenance-Free Operation



9

1943
1944
1945
1946
1947
1948
1949
1950
1951
1952

years without opening!

Two nine-stage CHT pumps were put into service at the Katy Cycling Plant in July 1943. These five-inch, double-case units, one of which is shown above, take lean oil at about 90°F. and 70 psi from the still after coolers and discharge it to the absorbers at 1850 psi. Throughout this entire nine year period, the pump casings have not been opened. The original bearing linings are still in service and the only maintenance required has been the renewal of inboard shaft sleeves and infrequent repacking. A third I-R pump of the same design, installed in 1944, has required no repairs to date.

This outstanding performance record is a typical example of the *extra dependability* that's built into every Ingersoll-Rand pump. Each unit is designed for real, long range economy that pays off in lower operating and maintenance costs year after year. If you have a pumping problem, your nearest I-R representative will be glad to help you.

IR

Ingersoll-Rand
Cameron Pump Division
11 Broadway, New York 4, N. Y.
779-10

COMPRESSORS • DIESEL & GAS ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

COPPUS "BLUE RIBBON" VENTILATORS

Used in wide variety of applications throughout industry

Improve workers' safety . . . health . . . comfort . . . efficiency

VANO DESIGN "A" VENTILATOR is used here during repairs to a chemical still. This type ventilator is used to ventilate tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments, fuselages and other confined places. Uses 8″ diameter flexible canvas tubing ("Ventube").

VANO DESIGN "B" VENTILATOR here discharges welding fumes from double-bottom compartment in naval vessel under construction. Large volume of air handled quickly expels fumes and results in good ventilation. Vano Design "B" can pass through opening only 14″ in diameter. Uses 8″ diameter flexible canvas tubing ("Ventube").

VANO DESIGN "C" VENTILATOR here withdraws fumes from a reactor kettle. This ventilator can be furnished with 8″ suction inlet for 8″ non-collapsible suction tubing — or multiple inlet nozzles for 5″, 4″, and 3″ suction hose. The discharge may be connected to 8″ "Ventube." Capacities furnished on request.

NO. 2 AEROPLANE HEAT KILLER here directs cool, fresh air on worker in drop forge plant. Heat killers restore workers' efficiency by providing extra ventilation in the hot months, or on any job where workers are continually or periodically required to work in excessive heat. Available in two types, three sizes in each.

VENTAIR DESIGN TE-4 VENTILATOR Gasoline Engine Driven, here delivers air into underground manhole. These ventilators provide fresh air to men in confined places, promoting safety, comfort, and increasing efficiency. Ideal where no electric current is available. Delivers 1700 CFM of fresh air. Uses 8″ diameter flexible canvas tubing ("Ventube").

PORTAIR NO. 4 BLOWER EXHAUSTER exhausts fumes resulting from soldering, welding, tank coating, is also used in ventilating small tanks. It is designed to permit attachment of 4″ flexible metal hose. Capacity: 425 CFM free air.

ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION, 211 PARK AVENUE, WORCESTER 2, MASS. Sales offices in Thomas' Register. Other "Blue Ribbon" Products in Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory and Mining Catalogs.

Please send me information on supplying fresh air to men working:

☐ in tanks, tank cars, drums, etc.
☐ in underground cable manholes
☐ in aeroplane fusilages, wings, etc.
☐ on coke ovens
☐ on steam-heated rubber processes
☐ on boiler repair jobs

COOLING:

☐ motors, generators, switchboards
☐ wires and sheets
☐ general man cooling
☐ around cracking stills
☐ exhausting welding fumes
☐ stirring up stagnant air wherever men are working or material is drying
☐ drying of walls, sheets, etc., after treated with coating material

Name ....
Company ....
Address ....
City .... Zone .... State ....

Write here any special ventilating problem you may have { ____________________

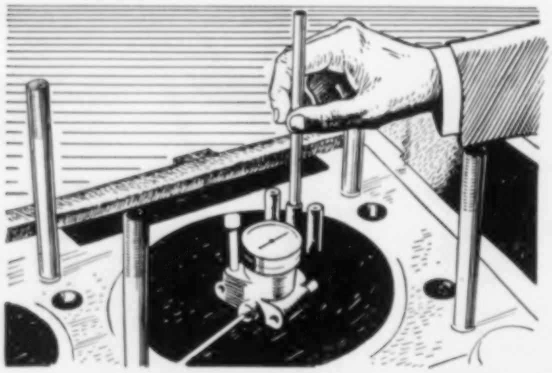
Cook job-engineered Piston Rings

...solve the case of the Prodigal Power Plant

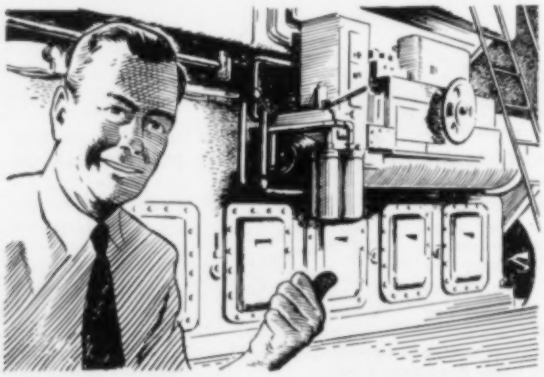
A large municipal power plant was being plagued by high maintenance and operating costs. Excessive ring breakage, cylinder lacquer and failure to hold compression pressures were the clues that pointed to the piston rings as the culprits. Despite the fact that the Chief Engineer rigidly observed the best operating procedures, the condition grew progessively worse. When it became necessary to pull pistons every 400 hours, he decided to call in Cook to make a "job-engineered" investigation of the mystery.

The Cook field man, who had been specially trained to diagnose diesel troubles, reviewed past performance data and suggested certain essential adjustments to "zero out" any operating variables.

A solution was recommended—but the Chief Engineer decided to make his own test. Old style rings were installed in 3 of the cylinders, competitive rings in 3 others and recommended Cook rings in the last 3 cylinders.



Results showed the old rings failed as quickly as before. The competitive rings stood up better but induced high rates of cylinder wear. Cook rings in operation for the same period revealed no ring failure, no lacquer and negligible cylinder wear.



The recommended Cook rings were installed throughout. After 4300 hours under full load, examination showed rings were still in perfect condition, no sign of lacquer and total cylinder wear only .0030". The prodigal power plant had returned to the fold.

Job Engineering is an exclusive Cook service which assures scientific selection and application of piston rings to your specific operating and engine conditions. Take advantage of it.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky.
Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK
PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

How many different oils and greases do you now carry to keep your earth-moving machinery running?

With Shell's "3-Barrel" plan you need only *three!**

*SHELL RETINAX A GREASE

. . . a superior new multi-purpose grease for all types of heavy-duty automotive vehicles. Shell Retinax A Grease does the job of four or more specialized greases—yet only one gun is required. Recommended for all grease-lubricated points on chassis, wheel bearings, universal joints, and water pumps, Shell Retinax A gives you better protection against excessive wear and washing out.

*SHELL SPIRAX EP†

. . . an exceptional "alloy type," Extreme Pressure gear oil. Shell Spirax EP is recommended for rear axles of the hypoid, spiral bevel, and spur gear types . . . and heavy-duty transmissions. It is extremely stable . . . has long-lasting anti-rust and film strength properties. Results: longer gear life, lower maintenance costs.

*SHELL ROTELLA OIL

. . . for all engine crankcase lubrication, Shell Rotella Oil is a new, fortified, extra heavy-duty lubricant which has set new standards of anti-wear, anti-fouling performance in high speed diesel and heavy duty gasoline engines. By maintaining clean engines and minimizing sludge formation, piston lacquering, ring and valve sticking, and port clogging, Shell Rotella Oil extends periods between overhauls, reduces parts replacement costs, and gives you reduced oil consumption.

†Some manufacturers recommend a straight mineral oil for gear lubrication. Your Shell Lubrication Engineer will suggest the proper lubricant in such cases.

SHELL OIL COMPANY,
50 West 50th Street, New York 20, N. Y.
100 Bush Street, San Francisco 6, Cal.

Please send me literature describing the 3-Barrel plan of lubrication.

Name ____________________

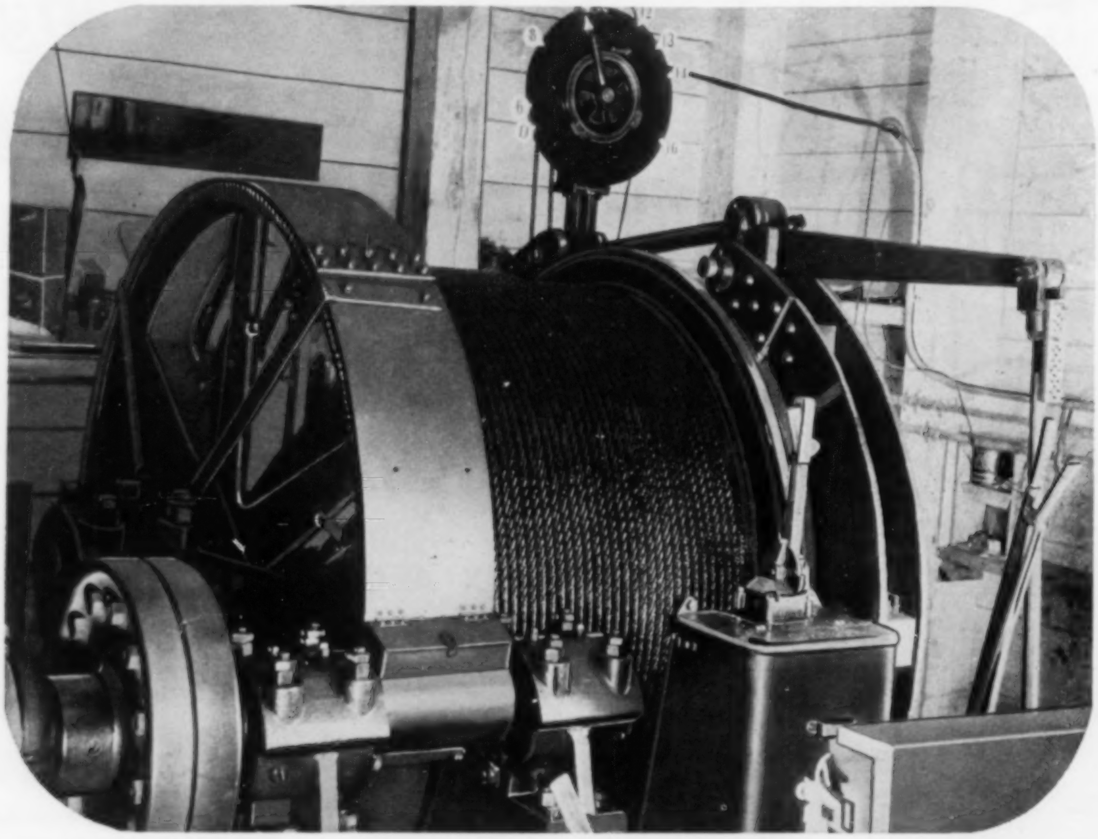
Company ____________________

Address ____________________

SHELL

SHELL "3 BARREL" LUBRICATION

WIRE ROPE



This is the longest-lasting rope we've ever made for mining

JUST MENTION wire rope and most everyone thinks of Roebling. For one thing, Roebling made the first wire rope in America. But what's more, we've always led in developing better wire rope for the needs of every branch of industry.

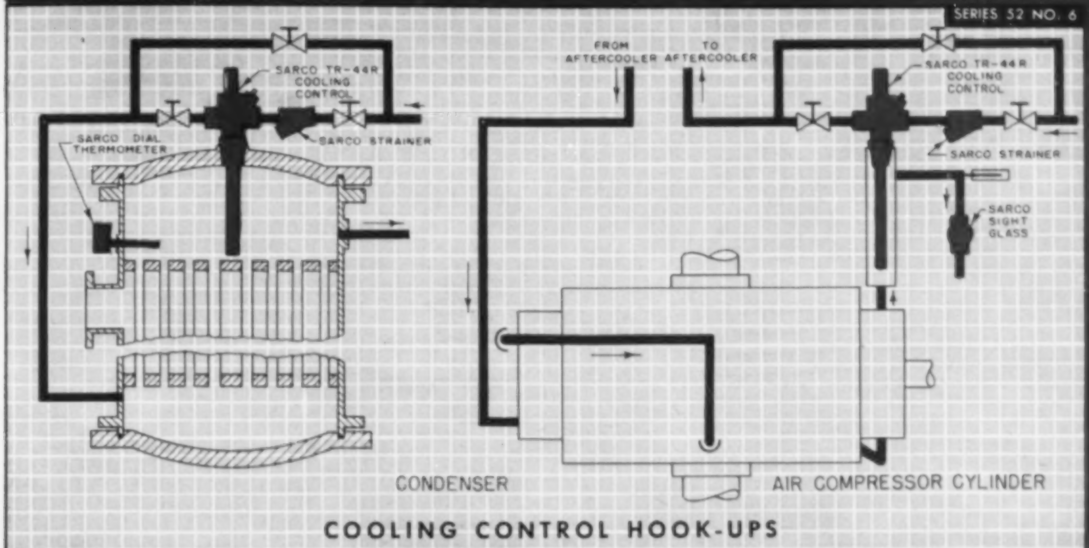
Roebling Preformed "Blue Center" Steel Wire Rope is today's best bet for mining service. It's safe, dependable and stands up under rough going. It saves you time and cuts costs.

There's a Roebling wire rope of the right specification for top service on any job. Call on your Roebling Field Man for his recommendations. John A. Roebling's Sons Company, Trenton 2, New Jersey.

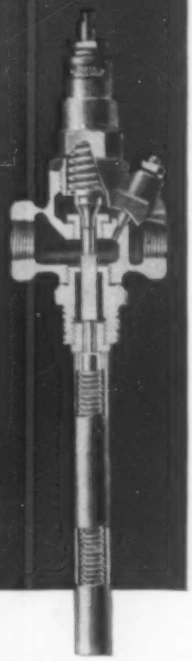
ROEBLING

ATLANTA, 934 AVON AVE • BOSTON, 51 SLEEPER ST • CHICAGO, 5525 W. ROOSEVELT RD • CINCINNATI, 3253 FREDONIA AVE • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST • DETROIT, 915 FISHER BLDG • HOUSTON, 6216 NAVIGATION BLVD • LOS ANGELES, 5340 E. HARBOR ST • NEW YORK, 19 RECTOR ST • ODESSA, TEXAS, 1920 E. 2ND ST • PHILADELPHIA, 230 VINE ST • SAN FRANCISCO, 1740 17TH ST • SEATTLE, 900 1ST AVE S. • TULSA, 321 N. CHEYENNE ST • EXPORT SALES OFFICE, TRENTON 2, N. J.

SERIES 52 NO. 6


SARCO TR-44R COOLING CONTROL
SARCO STRAINER
SARCO DIAL THERMOMETER
FROM AFTERCOOLER
TO AFTERCOOLER
SARCO TR-44R COOLING CONTROL
SARCO STRAINER
SARCO SIGHT GLASS
CONDENSER
AIR COMPRESSOR CYLINDER

COOLING CONTROL HOOK-UPS



Trouble-Free *Cooling Controls*

Endorsed by Equipment Manufacturers

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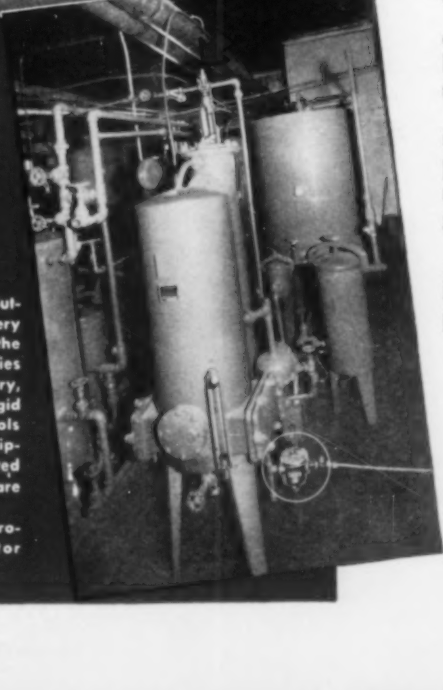

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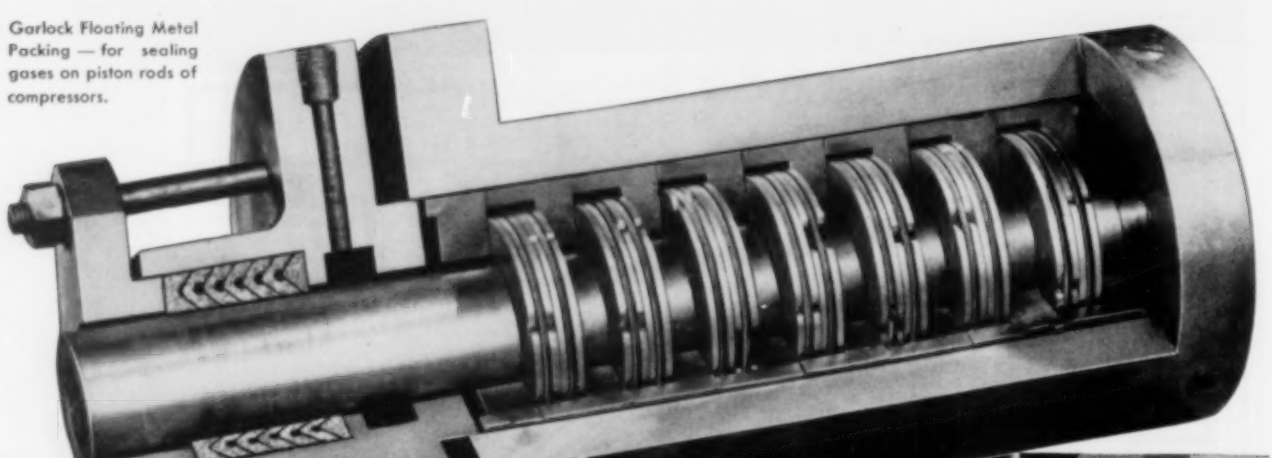

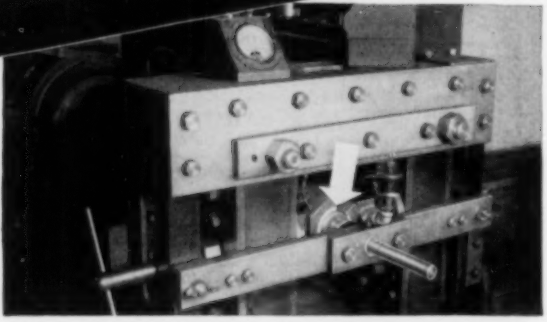

Above: Arrow points to foundry specimen being wear-tested on specially designed machine.

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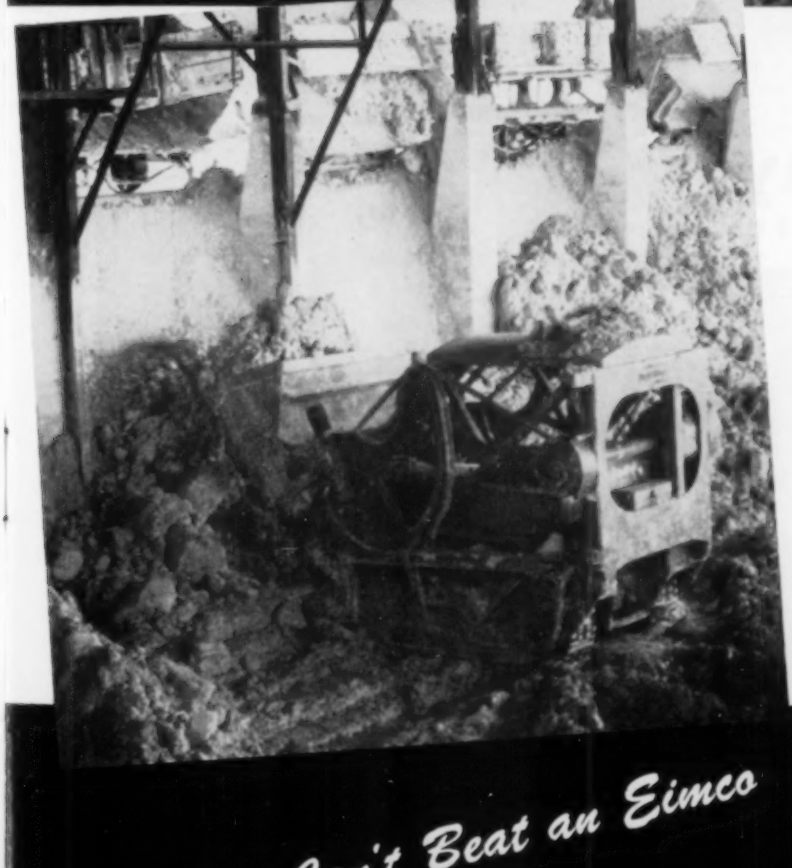

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ON THE COVER

BEFORE 1800, bucket bearers delivered water to most Paris homes and business places. Understandably, daily consumption was only about 4 gallons per capita—approximately 4 percent of the amount used currently. Later on, wealthy residents began to install private lines for their own needs, and fountains were built in public places where the populace might fill vessels. Vendors of the type shown did not disappear, however, until 1854, when the foundation of the present distribution system was laid. At the time depicted on our cover, water was selling for two sous per bucket.

IN THIS ISSUE

IN THE future much of our iron ore will come from the huge Lake Superior deposits of low-grade ore known as taconites. In its survey of current and projected mining expenditures, the President's Materials Policy Commission, headed by William S. Paley, predicted that the largest investment in any single branch of the mining industry during the next few years will go towards providing facilities for mining and beneficiating that material. Our leading article summarizes forthcoming developments in this intriguing field.

•

WHEN outmoded equipment is replaced by something more modern, the old installation is usually removed and often scrapped. At Hamilton, Ont., however, ponderous beam-type pumps almost a century old are still in place and in working condition in the city's waterworks. Consequently an opportunity is offered there to compare the type with the much smaller but more powerful Cameron centrifugal units now in service. Page 304.

•

BEGINNING on page 307, G. J. Constantini resumes the tour of underground Paris that he started last month. Prominent in this concluding installment are descriptions of the compressed-air distribution system and the pneumatic-tube network.

•

DEVELOPMENT of an air jack by Col. Leon B. DeLong was the key to the success of a new method of building steel piers. As described (page 312), they can now be made by fabricating barges, towing them to the point of use, and then converting them into a stable connected structure supported on large pipes that extend down through the deck to a solid footing.

Compressed Air Magazine

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EDITORIAL CONTENTS

Iron from Taconites—*J. C. Pierce* 300
Pumps Tell Story of Progress—*J. P. Smallwood* 304
Paris Underground, Part 2—*G. J. Constantini* 307
Barges That Turn into Piers—*James Hirt* 312
Taking the Fog Out of Jet Planes—*John Starr* 314
Tunes from Grinding Wheels 316
Gotham May Get "Rubber Subway" 317
Editorials—Rosy Future for Mining—Hungry Horse Dam 318
This and That 319
Jackrolling 320
Mobile Refrigerator and Cold-Storage Plant 320
Compressed Air Institute Acclaimed 320
Industrial Notes 321
Quotes from Here and There 325
Industrial Literature 327

ADVERTISING CONTENTS

Adams Co., Inc. R.P. 33
Allis-Chalmers Mfg. Co. 36
Bethlehem Steel Company 6
CCA Division-Breco Mfg. Co. 37
Combustion Engineering-Superheater, Inc. 29
Compressed Air Magazine Co. 35
Cook Mfg. Co., Inc. C. Lee 12
Coppus Engineering Corp. 11
Crucible Steel Co. of America 3rd Cover
Dollinger Corporation 3
Eimco Corporation, The 17, 27
Electric Machinery Mfg. Co. 9
Elliott Company 5
Galland-Henning Mfg. Co. 37
Garlock Packing Company, The 16
General Electric Co. 41, 42
Goodall Rubber Company 35
Goodrich Company, The B.F. 26
Hansen Manufacturing Co., The 4
Hercules Power Company 25
Ingersoll-Rand Company 2nd Cover, 10, 39, 40
Logan Engineering Co. 37
Manhattan Rubber Division 8
Maxim Silencer Co., The 24
Naylor Pipe Company 23
New Jersey Meter Co. 38
Niagara Blower Company 22
Nicholson and Company, W. H. 35
Norgren Co., C.A. 38
Norton Company 18
Raybestos-Manhattan, Inc. 8
Roebling's Sons Company, J.A. 14
Sarco Company, Inc. 15
Sauerman Bros., Inc. 20
Schraders' Sons, A. 28
Shell Oil Company 13
Square D Company 38
Texas Co., The .... Back Cover
Timken Roller Bearing Co., The 7
Toledo Pipe Threading Machine Co., The 43
Victaulic Co. of America 21
Vogt Machine Co., Henry 30
Walworth Company 34
Westinghouse Electric Corp. 31, 32
Wisconsin Motor Corporation 19

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Iron from Taconites

Nation's Major Steel Companies Are Preparing to Dig and Treat Huge Deposits of Low-grade Ore

J. C. Pierce

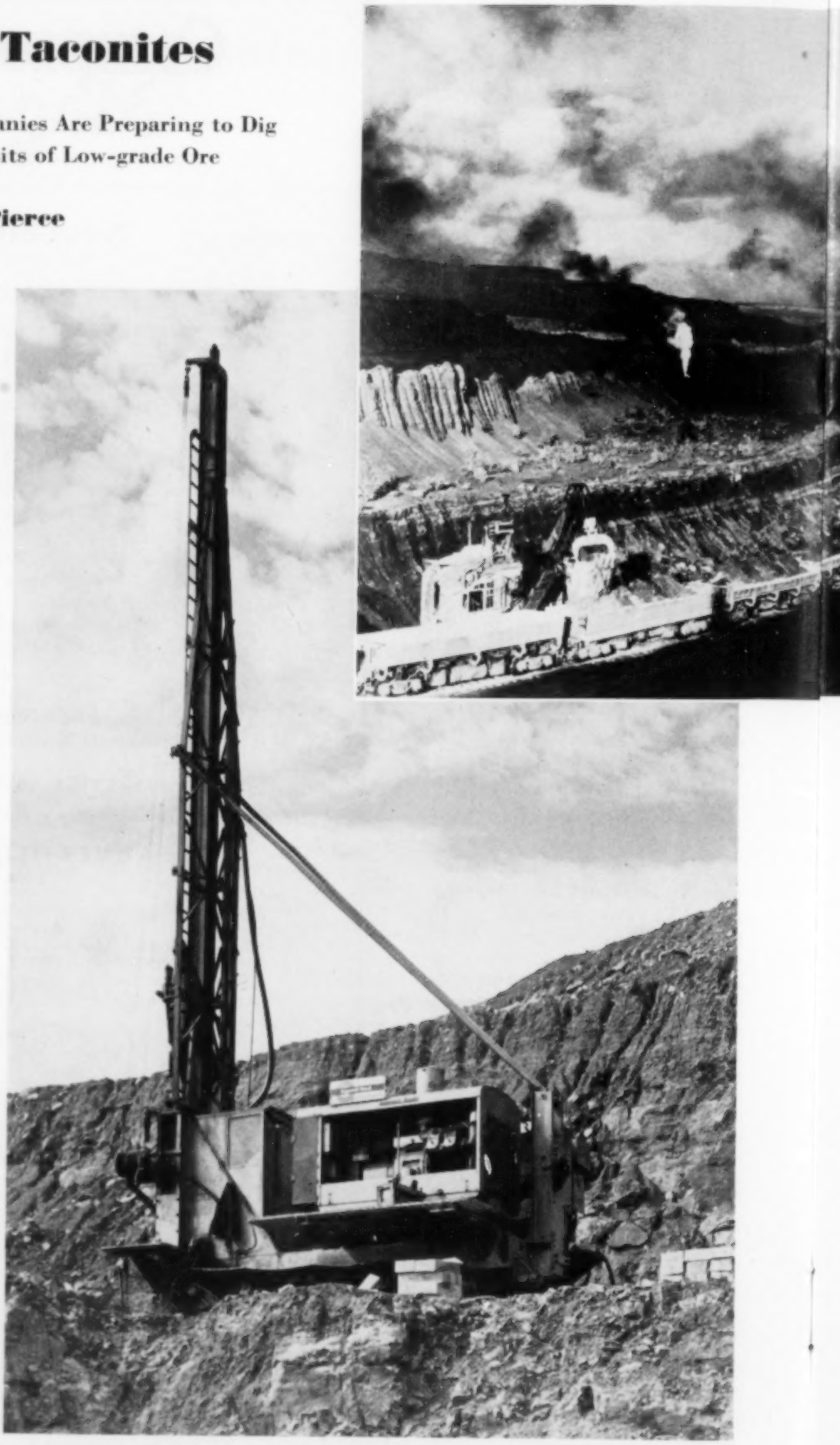
AMERICAN blast furnaces get their iron ore from many sources, but for the past 35 years at least two-thirds has come from the iron ranges of northeastern Minnesota—the world's most productive iron-ore region. Hence, iron-ore miners and steelmakers were not greatly surprised when, more than a decade ago, the boundaries of many of those high-grade Minnesota deposits were at last seen and the end of that ore reserve could be forecast with reasonable accuracy.

With that ominous development the United States became uneasy about future supplies of this basic mineral, and an intensified search for iron ore began. It included appraising known deposits and prospecting for new ones anywhere on the globe within reasonable shipping distance of America. Ironically, it was known that there was no shortage of iron in the Minnesota ranges, not considering probable new discoveries.

Adjacent to the depleting high-grade pits were vast bodies of iron-bearing (25 to 30 percent) rock containing enough of the metal to meet the nation's requirements for centuries, according to some estimates. The iron and steel people were disturbed only because those reserves, known as "taconites" and then economically submarginal, might not become merchantable in time to supplant the dwindling better-grade ores favorably located with regard to United States furnaces. Research was conducted to find a means of winning the mineral from this flint-hard rock at a cost low enough to justify the enormous amount of money and effort that would have to be expended.

This dire need, combined with American industrial ingenuity and resourcefulness, has resulted in a reassurance that the steel empire will not soon be restrained by an iron-ore shortage. Economic adjustments and technological advances are opening the taconite deposits of Minnesota's Vermillion, Mesabi and Cuyuna ranges and some $400 million worth of construction is now being directed towards production.

Unlike the softer hematite from Minnesota, taconite can't be scooped up with giant power shovels and draglines without the benefit of blasting. It is a hard rock and presents correspondingly difficult drilling and blasting problems. Too, the iron minerals are disseminated in

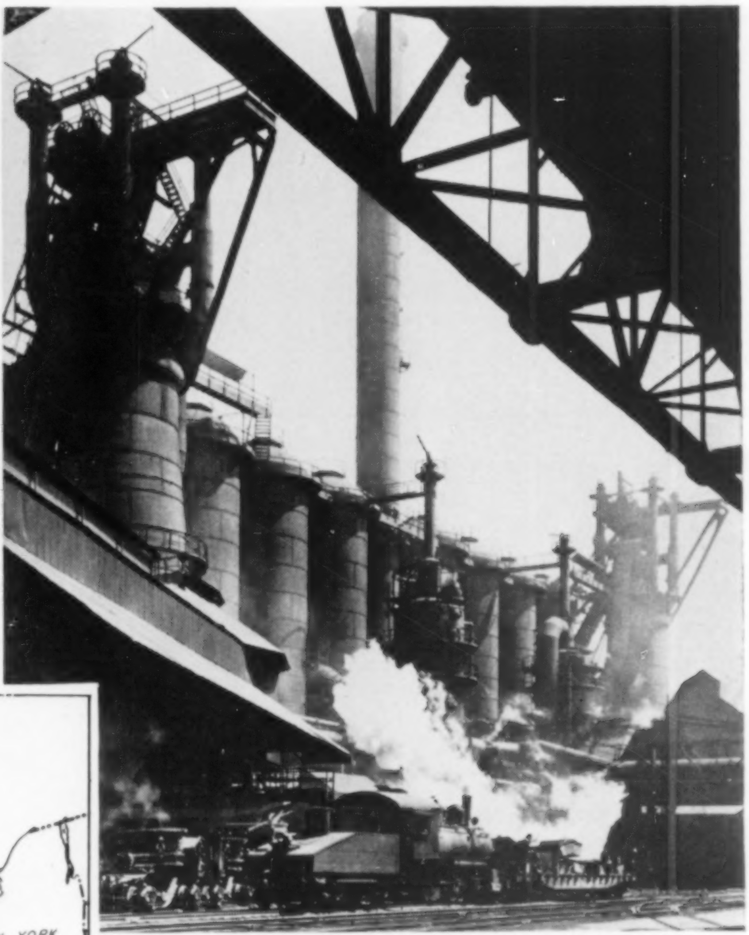


HEAVY-DUTY DRILL

The flint-hard taconites are more obdurate than the hematite deposits previously extracted and call for different drilling techniques. At Mountain Iron and Virginia, Minn., the Oliver Mining Division of United States Steel Corporation uses Ingersoll-Rand Quarrymaster drills to put down large-diameter holes for effective blasting. The machines are self-contained, self-propelled plants mounted on crawlers and capable of drilling 6-inch holes to depths of 70 feet. Each carries two air compressors to operate the drill and auxiliary air motors. Conforming with Oliver practice, the compressors on these units are driven by electric motors.

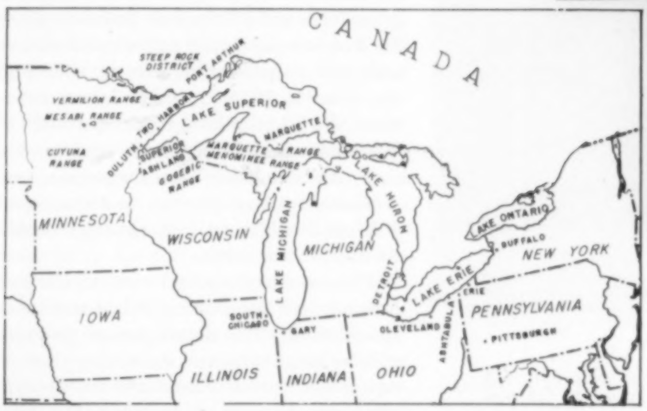
PIT ON MESABI RANGE

North and east of the headwaters of the Mississippi, close to the Canadian border, lies the Mesabi Range. Shallow glacial overburden was removed to expose the ore, which was then scooped out to form yawning pits such as the one pictured at the left. The end of these huge hematite ore bodies is now in sight.



WHERE ORE BECOMES IRON

The ultimate destination of iron ore is the blast furnace. There it is smelted with the aid of coke and limestone, while tornadoes of compressed air supply oxygen to produce the melting heat. Shown above are two of the twelve large blast furnaces operated by the United States Steel Company at Gary, Ind.


CANADA
STEEP ROCK DISTRICT
PORT ARTHUR
VERMILION RANGE
MESABI RANGE
CUYUNA RANGE
TWO HARBORS
DULUTH
SUPERIOR
ASHLAND
GOGEBIC RANGE
LAKE SUPERIOR
MARQUETTE
MARQUETTE RANGE
MENOMINEE RANGE
LAKE HURON
MINNESOTA
WISCONSIN
LAKE MICHIGAN
MICHIGAN
LAKE ONTARIO
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ERIE
ASHTABULA
PENNSYLVANIA
PITTSBURGH
IOWA
SOUTH CHICAGO
GARY
CLEVELAND
ILLINOIS
INDIANA
OHIO

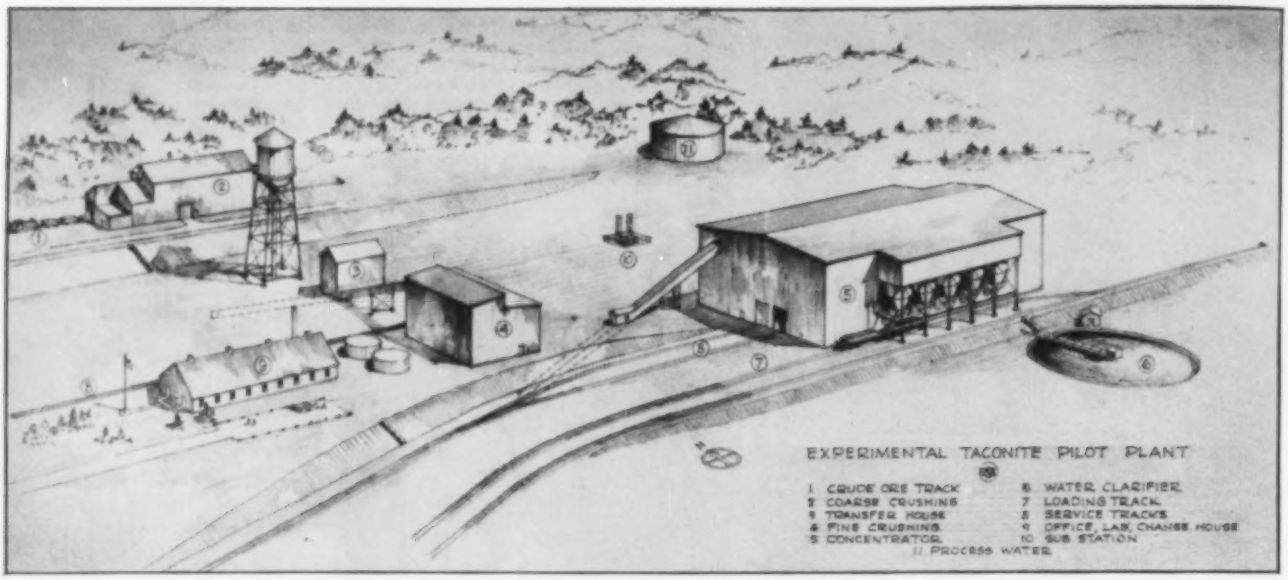
LAKE SUPERIOR IRON RANGES

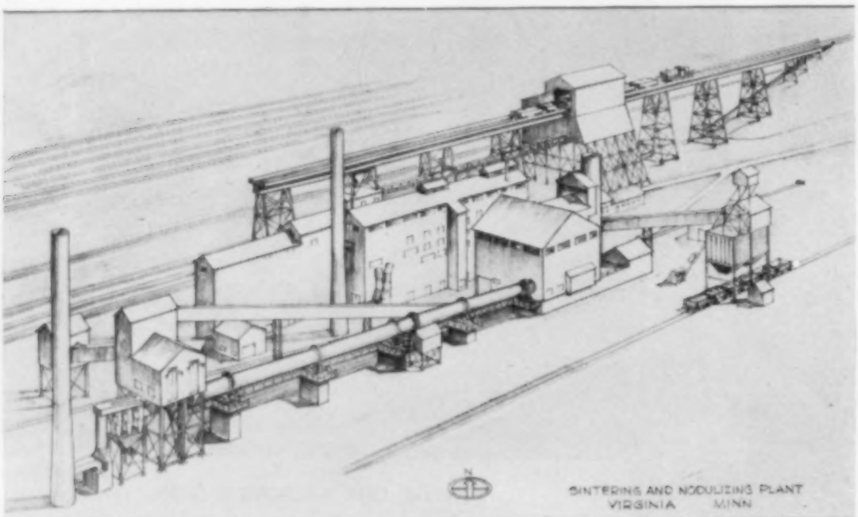
Map shows locations of the main sources of hematite ore for the United States steel industry during the past half-century. With the exception of the Steep Rock district in Canada all the deposits are nearing depletion of their high-grade ore, but some still contain millions of tons of taconite-bearing rock from which much of our future supply will come. The cities indicated are the principal steelmaking centers which normally receive much of their ore from the Great Lakes deposits.

such a finely divided state that the rock must be ground to powder to liberate them. Such operations are costly and call for the best quarrying and reduction equipment.

There are two main classifications of taconite—magnetic and nonmagnetic. The first contains iron principally in the form of magnetite—the iron oxide that is attracted by a magnet and itself is sometimes magnetic. The beneficiation of the ore is simple enough after the expensive mining and more costly grinding have freed the tiny magnetite particles from the rock mass. Magnetic separators recover it in a continuous process as a nearly pure product that may contain up to 70 percent iron. Known reserves of this class of taconite in Minnesota are large and several high-tonnage operations have been initiated. Each is expected to yield ten million tons of that type of concentrate per year for more than 50 years. Reserves of the nonmagnetic variety are probably much bigger than those of the magnetic taconite. In them the iron is in other forms such as silicates, carbonates and the oxide hematite that present more expensive and complex metallurgical problems.

The Minnesota deposits are not new discoveries nor have their potentialities gone unheeded. The Mesabi Iron Company, founded in 1916, mined and beneficiated magnetic taconite at Babbitt, Minn., between 1922 and 1924. The venture was premature in the face of the low-cost production of the then abundant high-grade hematite ores of the ranges. Today the Reserve Mining Company, one of the combines headed for large-scale taconite output, is leasing the extensive Mesabi Iron Company taconite holdings under a long-time arrangement and is rebuilding its Babbitt plant into a pilot plant with an annual capacity of 300,000 tons. Reserve is also erecting a $75 million beneficiation plant at Beaver Bay, Minn., and connecting it with Babbitt by railroad. It is scheduled for 1955 production and will be the first of four 2.5-million-ton units designed to yield a concentrate with an





EXPERIMENTAL TACONITE PLANTS

Architect's drawings of two United States Steel Corporation pilot plants in Minnesota in which beneficiation processes are being worked out prior to the construction of full-scale establishments. The plant shown at the top will produce annually 500,000 tons of iron concentrate from two million tons of crude taconite ore. This fine-as-flour material will then be shipped by rail to the second plant (lower drawing) where it will be agglomerated into clinkers and egg-size nodules suitable for charging blast furnaces.

iron content of more than 60 percent.

Besides Reserve, which is a partnership of American Rolling Mill Company and Republic Steel Corporation, other major iron and steel operators are launching drives towards taconite production. The Erie Mining Company, which is owned by Bethlehem Steel Corporation, Youngstown Sheet & Tube Company, Interlake Iron Corporation and Pickands, Mather & Company, has nearly completed plans for its first 2.5-million-ton-per-annum plant at Aurora, Minn., after more than three years of pilot-plant operation. Erie is spending $300 million on facilities for processing the tough ore that is largely counted on to sustain the American steel industry for centuries. It, too, is aiming towards an annual capacity of ten million tons. United States Steel's Oliver Iron Mining Division has conducted extensive research in taconite beneficiation and is now building a pilot plant at Mountain Iron, Minn. It is to start running next year, treating about two million tons of taconite to obtain 500,000 tons of concentrate annually.

An experimental taconite agglomeration plant of 500,000 tons annual capacity has already been constructed by Oliver Iron Mining Division at Virginia, Minn., to handle the concentrates from the pilot taconite concentrating plant. Two forms of agglomeration, sintering and nodulizing, will be tried out there.

Taconite developments are not confined to Minnesota. The newly formed Humboldt Mining Company, owned jointly by Cleveland-Cliffs Iron Company and Ford Motor Company, is building two 200,000-ton-per-year concentrating units to treat the iron-bearing rock of the old Humboldt Mine of the Marquette Range in northern Michigan. This will be the first flotation plant for iron ore, and it is expected that one unit will be producing late in 1953 and the other in 1955. And for future reference, the 70-mile-long Gogebic Range of Wisconsin and Michigan is under scrutiny. Its low-grade iron formation, predominantly nonmagnetic, averages about 550 feet in width as it dips steeply northward into the earth.

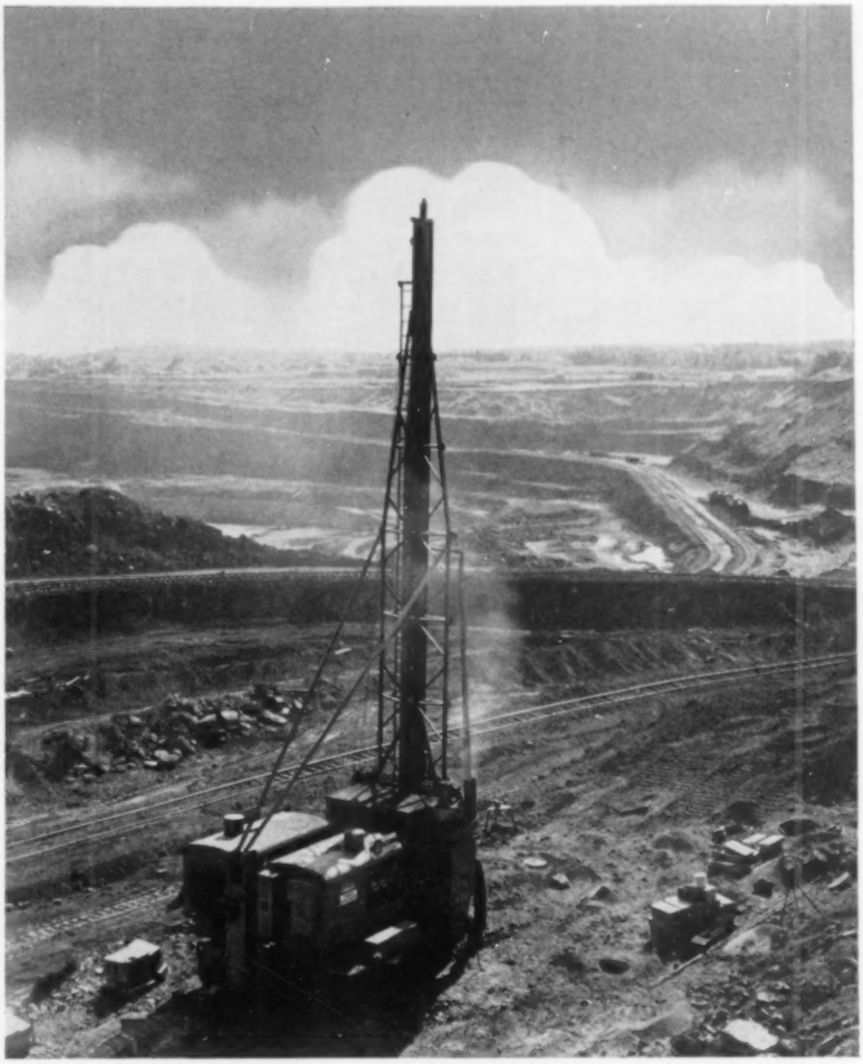
The eventual annual contribution of furnace feed from taconite is a matter of speculation. The development program will be long, slow and expensive, but no one is too worried about the future supply even though it is estimated that American industry, which used 97 million long tons of iron ore in 1950 and around 116 million in 1951, will require 135 million tons annually two decades from now. At that time—1972—the industry will, so authorities believe, get about twenty million long tons yearly from the Labrador-Quebec holdings of the Iron Ore Company of Canada, owned in part by five United States companies. The new finds in Venezuela, controlled by American steel interests, are expected to contribute twenty million long tons each year. Liberian and other African producers are counted on for one million tons, and all other foreign sources for an aggregate of four million tons.

It is estimated that the Lake Superior district, including the Steep Rock area just across the border in Canada, will yield 30 million long tons annually from newly discovered deposits, from "missed" ore in old pits and underground workings, and from lower-grade segments of high-grade ores upgraded by simple methods. The expectations are that the 60-million-ton deficit will be offset by concentrates from taconite beneficiation. Although not included in this appraisal, new finds and unforeseen extensions of present producers at various scattered locations may supplement the 1972 output appreciably. For example, the long-productive iron belt along a part of the east coast including New Jersey, Pennsylvania and New York may, through modern prospecting methods, reveal extensive reserves.

For about 30 years, figures on merchantable iron ore have been based on material containing about 51.5 percent iron, of course with specified limits as to certain common impurities detrimental to steelmaking. Concentrate from taconite beneficiation plants will probably average more than 62 percent. Tests have shown that it can be a superb furnace material, and that its higher production cost will be offset by a saving in smelting costs. Further, its superior grade will measurably prolong the life of mines containing subgrade ore because the material from the latter can be blended with the concentrate to make a final product with an iron content of approximately 51.5 percent.

Beneficiation of subgrade iron ore, as differentiated from taconite treatment, is an old practice in Minnesota. Even in the early years of mining the work of sorting and washing out small amounts of diluting detrital matter to boost the ore, chiefly hematite, above the minimum iron-content limit was done on a small scale at many points. Since then some revolutionary concentrating processes have been tested there. By 1940 upgrading ore was a common procedure, and nearly 20 percent of the material shipped from the region was beneficiated. That figure had risen to a little more than 30 percent by 1950 Some ores need only simple washing to upgrade them sufficiently, others are concentrated by gravity separators of one kind or another such as Humphreys Spirals, heavy-media units, jigs, etc. But there is little parallel between the scope of the problems involved in upgrading marginal iron ores and in separating the iron minerals from the dense ground mass in taconite.

As previously pointed out, there are magnetic and nonmagnetic taconites. In addition, there are other variables that determine the beneficiation processes and the types of equipment to be used. In one deposit of magnetic taconite there may be a wide spread in concentration, a difference in physical characteristics of both the mineral and the rock, and association with nonmagnetic-iron minerals that must be saved for subsequent treatment and recovery. Even after recovery of the iron minerals the battle isn't won. Their conversion into chemical forms suitable for blast-furnace consumption poses a tough problem. Reconstituting the concentrates into physical forms that can be efficiently transported and fed to furnaces has been a major headache.

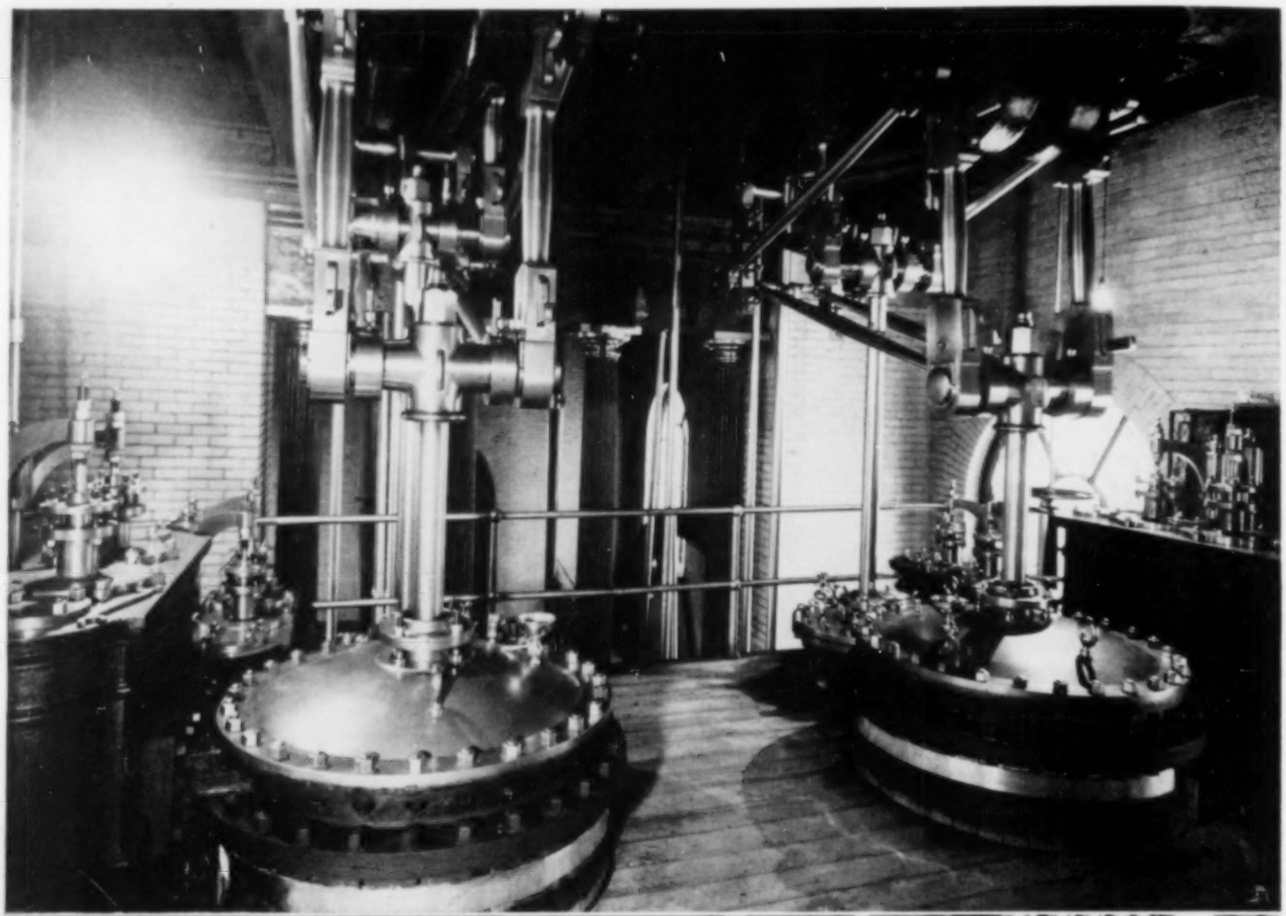


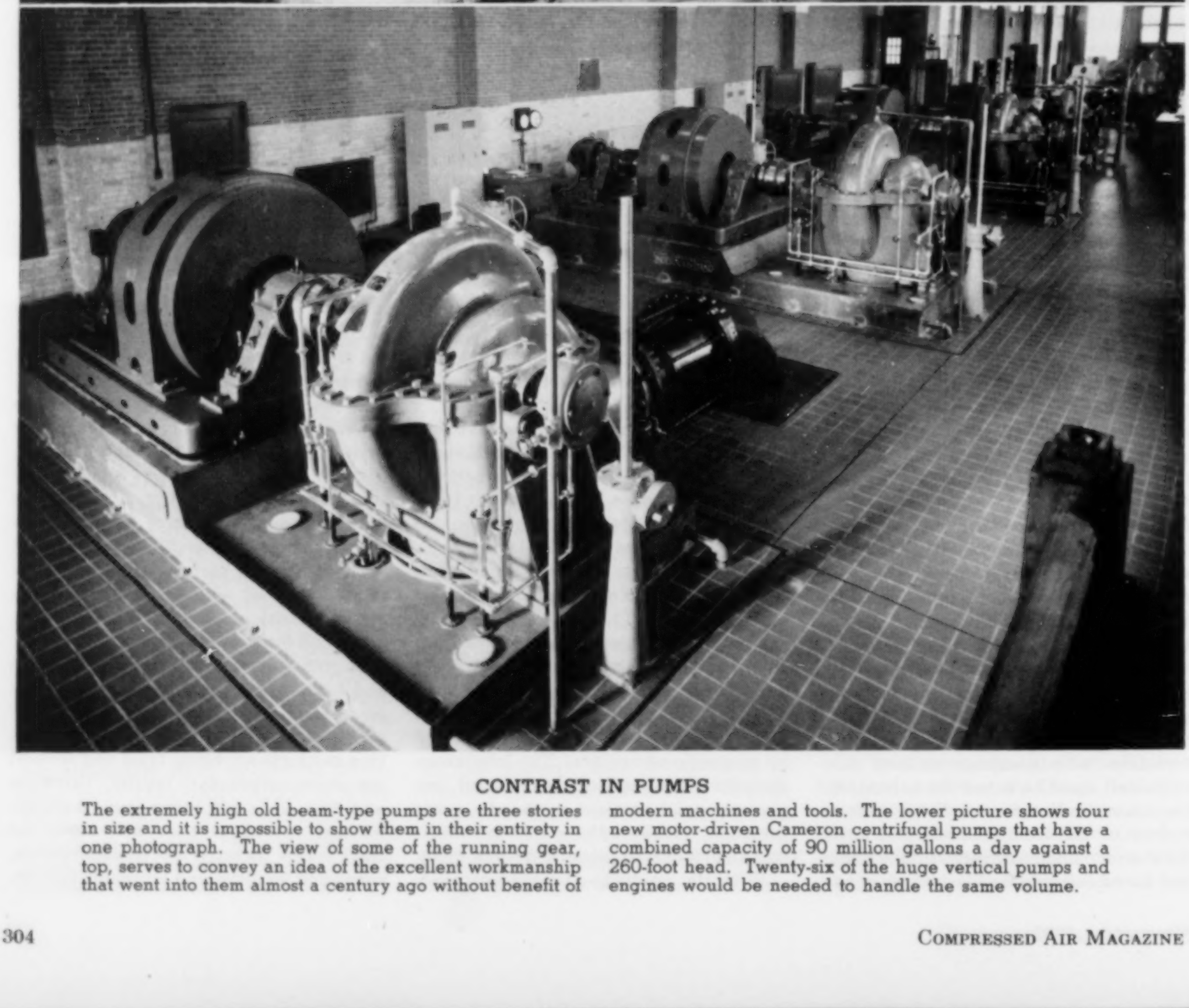
ANOTHER QUARRYMASTER VIEW

Beyond the drill may be seen one of the enormous pits from which huge quantities of ore have been extracted.

In attacking the difficulties involved in the recovery of the nonmagnetic iron minerals probably every known method, and many new ones, were given fair trial. It has been decided, although research is still in progress both in laboratories and in pilot plants, that the answer lies in converting the nonmagnetic into the magnetic form. This is done by heating the minerals to high temperatures by a closely controlled process in which gases and other additives serve as reducing agents. The resultant magnetic iron can be reclaimed from the detrital material by magnetic separators. The laboratory procedure has long been understood, but a commercial method to handle great tonnages within tight economic limits was an obstacle to taconite development.

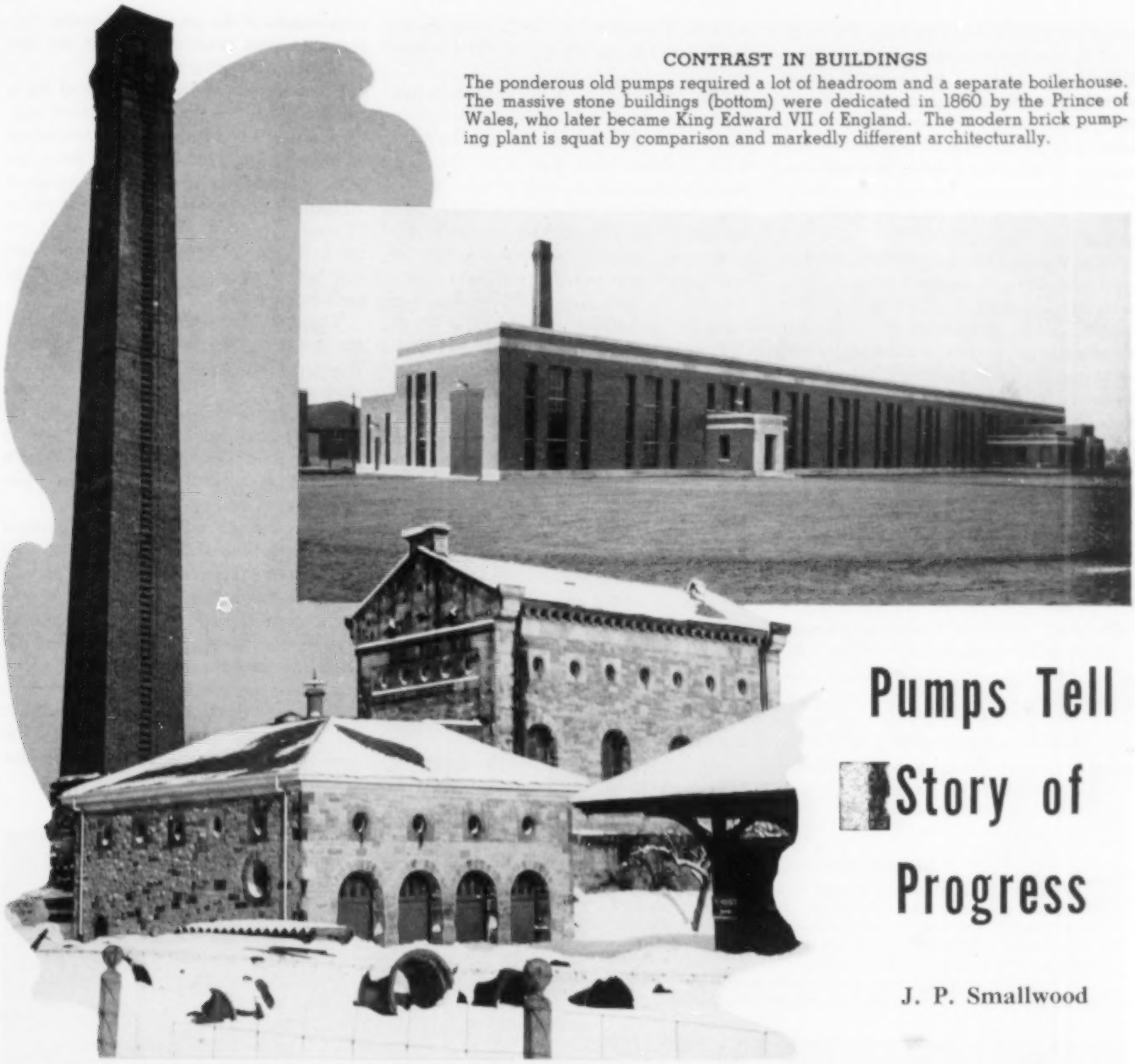
With the product—the concentrate—in dust-like form, it would be difficult to handle in transit and would be carried out of the furnaces with the blasts of the process gases. At or near the beneficiation plants it is therefore necessary to convert the powderlike concentrate into lumps the size of a walnut or larger. That is generally termed "agglomerating," and has taken many forms by as many methods. Most of them involve heat-treating and hardening, with or without binding materials, to make sintered lumps or nodules that will withstand attrition caused by handling. Some call for the application of pressure, with and without heat, to make pellets and briquettes. One experimental process resorts to vacuum extrusion. Different combinations of these reconstitution methods are being tried and several are giving satisfactory results. But time and trial alone will bring about a standardized procedure that will meet the rigid terms dictated by transportation, furnacing facilities and economic factors.





CONTRAST IN PUMPS

The extremely high old beam-type pumps are three stories in size and it is impossible to show them in their entirety in one photograph. The view of some of the running gear, top, serves to convey an idea of the excellent workmanship that went into them almost a century ago without benefit of modern machines and tools. The lower picture shows four new motor-driven Cameron centrifugal pumps that have a combined capacity of 90 million gallons a day against a 260-foot head. Twenty-six of the huge vertical pumps and engines would be needed to handle the same volume.



CONTRAST IN BUILDINGS

The ponderous old pumps required a lot of headroom and a separate boilerhouse. The massive stone buildings (bottom) were dedicated in 1860 by the Prince of Wales, who later became King Edward VII of England. The modern brick pumping plant is squat by comparison and markedly different architecturally.

Pumps Tell Story of Progress

J. P. Smallwood

BECAUSE of the volume and variety of its industrial products, Hamilton, Ont., is often called the "Pittsburgh of Canada." That progressive city, located at the extreme western end of Lake Ontario, is not only the Dominion's leading manufacturer of primary iron and steel but also turns out a miscellany of allied and other products including machinery, sheet-metal items, wire, hardware, tires and textiles. Like Pittsburgh, Hamilton is an important center of the electrical industry, with sixteen plants having an output that is second in dollar value only to iron and steel.

Hamilton's growth was fostered by heavy capital investments from across the border and, like that of Pittsburgh, paralleled the great advances in metallurgical and electrical technology which marked what is often called "the second industrial revolution" which dates from around 1870. The story of the city's engineering progress can perhaps best be told by tracing the development of its waterworks—by comparing its new plant, housing sleek high-lift centrifugal pumps, with the old one with its nearly century-old units of the massive walking-beam type, probably the oldest of the kind in North America. These pumps are a combination of the lever-on-a-fulcrum type used by ancient Egytians to raise well water and of the Saxon wooden, hand reciprocating pump of the sixteenth century.

The first practical engine-driven walking-beam pump was introduced by Thomas Newcomen in 1705 and was used for dewatering mines. Improvements on the Newcomen engine by James Watt in 1765 theoretically made the beam pump obsolete, but in practice it was such a convenient driver for pump rods and valve rods that it remained in service for well over a century after that date.

The two old pumps at Hamilton, which are technically described as fore-and-aft condensing beam-engine units, typify equipment that was used during the latter part of the nineteenth century before the refinement of the centrifugal pump and the development of the steam turbine, the electric motor and the internal-combustion engine. They were installed back in 1859 in a tall stone building which was dedicated by King Edward VII in 1860 when touring Canada as the Prince of Wales. Originally designed to handle a total of 3½ million gallons of water daily, their combined capacity was later increased to 5 mgd by reaming their cylinders.

According to City Engineer and Manager of Waterworks W. L. McFaul, the pumps could be put into service with no great trouble because they have been well maintained through the years and the original wood-lagged boilers are still in good condition. Photographs accompanying this article show the fine workmanship that went into their manufacture at a time when mechanical grinders and other modern finishing tools were nonexistent. In fact, casting the large walking beams would be considered a difficult job today. Two Osborne-Killey pumps were brought into operation in 1887, but between 1859 and that date the beam pumps carried the whole load of a rapidly developing community and apparently underwent no serious modification other than the reaming operation mentioned.

In sharp contrast to these reliable but cumbersome units are the four new Cameron high-lift pumps which, along with a control desk designed by Canadian Westinghouse, present a pleasing picture of compact, modern design. One is an 18-inch HHV with a rated daily capacity of 15 million gallons under a head of 260 feet, the others are 24-inch units of the same type rated at 25 million gallons each, also under a 260-foot head. They are of the centrifugal, horizontally split single-stage type and each is equipped with a tilting-disk check valve and an electrically operated gate valve made by the Dominion Engineering Company of Montreal. Another Cameron pump, a 2-stage 6GT centrifugal, serves as a booster in that section of Hamilton's residential area known as "The Mountain." This unit is driven by a 200-hp motor and has a capacity of 1666 gpm (United States) against a total head of 380 feet. Though remote from the main pumping station, it is a part of the general modernization plan of the water distribution system.

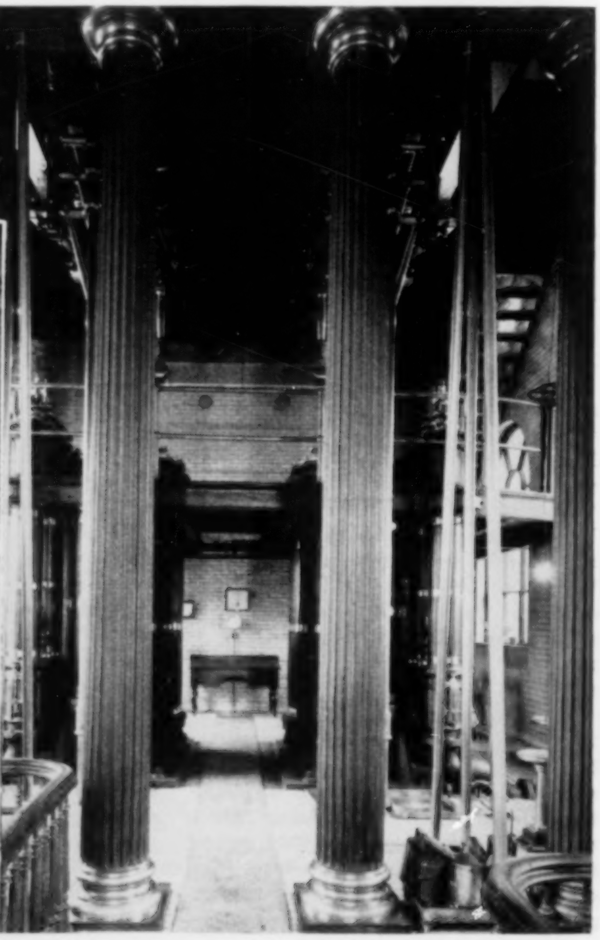
The four central pumps replace six high-lift units which were installed after 1910. One of the latter was driven by a steam turbine and five were electrics that operated on 25-cycle power. However, through a recent area-wide conversion project in southwestern Ontario 60-cycle current is available for the Westinghouse synchronous motors which operate the new pumps. Those on the three 24-inch units produce 1750 hp at 750 rpm; and the drive on the 18-inch pump is 1000 hp at 750 rpm.

Hamilton's waterworks program also calls for the expansion of its distribution system which steps down from two 48-inch main headers, and the construction of a 35-million-gallon reservoir which will increase the storage capacity by 250 percent. This work is now underway. Already completed is the pump house and a filtration plant consisting of twelve rapid sand filters and of modern equipment for mixing, flocculation and settling. The long low lines of the new pumping station are in sharp contrast to those of the towering stone building containing the old beam pumps. Welded steel piping fabricated by the Hamilton Bridge Company and installed by the Canadian Comstock Company contributes to the modernness of the plant, as does the venturi metering system provided by the Control & Metering Company.

Pumping efficiency is indicated by a comparison of ratings and actual performances. A. Murray, superintendent of the pumping station and filtration plant, has had the 18-inch HHV rated at 15 million gallons daily delivering up to 22 mgd. In April, 1952, only one of the three 24-inch pumps was required, and the operating level was 34 mgd at 90 pounds pressure.

The great progress in pump engineering made during the past 100 years is brought home to us when we learn that thirteen of the original cumbersome beam-engine pumps would be needed to replace just two of the modern Cameron pumps—and then solely on the strength of a gallon-per-day rating at low pressure.

The over-all waterworks expansion program is headed by Mr. McFaul, who was honored last year for his long service record in the field of public works by the Samuel A. Greely Award presented to him by the American Public Works Association. He is assisted by W. H. Collins, deputy city engineer; J. Stodart, waterworks designing engineer; and D. H. Matheson, chemist and bacteriologist, all with years of service in the department.



GRECIAN TOUCH

Corinthian columns, right, impart a touch of beauty to the interior of the old pump building. Beyond them may be seen parts of the two pumps which extend from the floor to and through the ceiling, with an intermediate level to provide access to some of the mechanisms. Below are shown the massive walking beams, the casting of which would even today give the foundryman some real problems.

Paris Underground

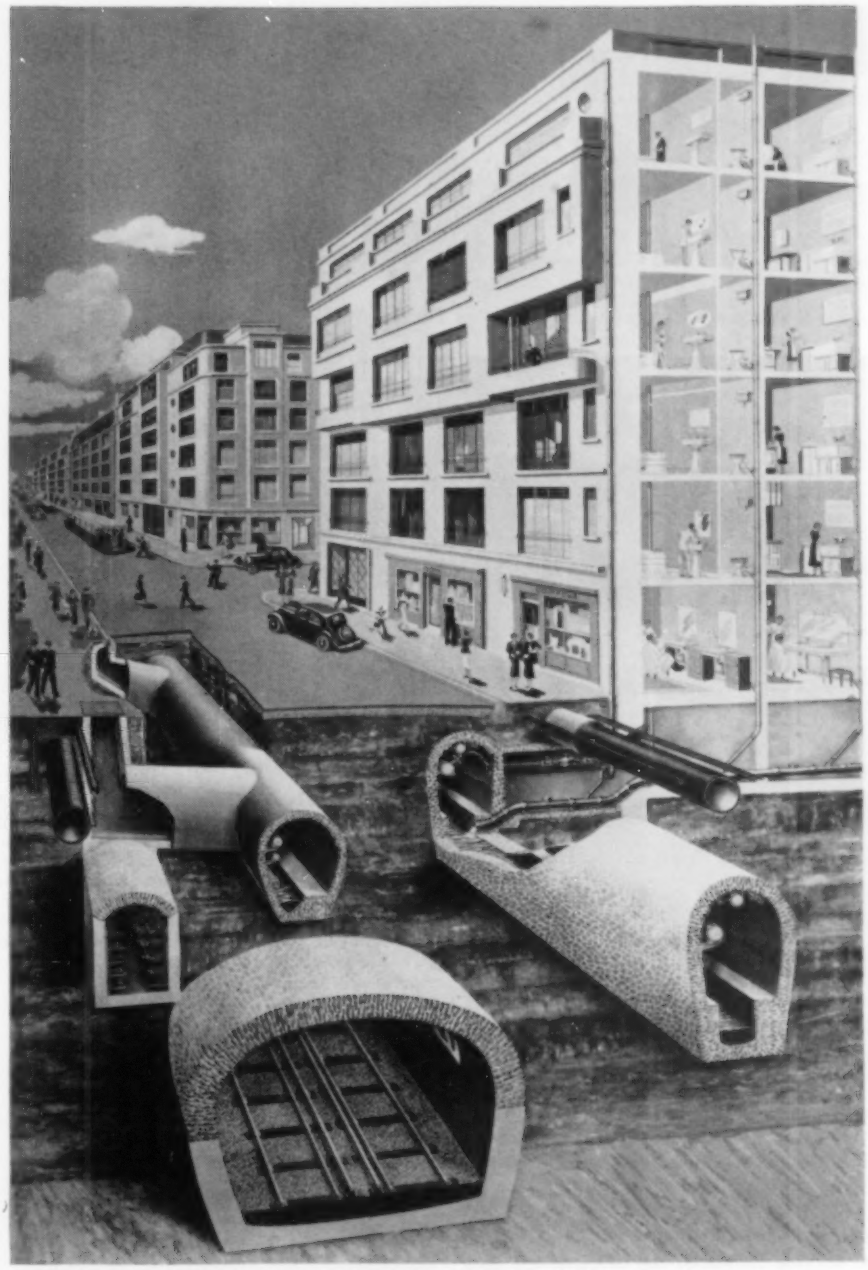
Pneumatic Tubes, Compressed Air Lines and Water Pipes Run Under the Streets

G. J. Constantini

Part 2

PARIS is the only city in the world where one can get compressed air the same as electricity, gas and water. The creation of this now huge air-distribution network dates back to 1880 when Victor Popp set up a small compressor plant to operate public pneumatic clocks located at different points throughout the city (some were still running after 47 years of service). Popp's idea was to create a system capable of distributing compressed air for varied applications to customers living in the Paris area, and later installed a second plant of 2000 hp serving 8 miles of pipes. The air supplied was then used to power elevators changed from hydraulic to hydropneumatic operation, as well as air motors for driving dynamos and other machines.

By 1892 the air service was well established, and a company named Compagnie Parisienne d'Air Comprime was organized and took over Popp's licenses and installations. By special arrangement with the city, the concern was authorized to build several compressor plants in Paris and to lay a network of pipes underneath the streets to carry air everywhere in its environs. Rent was paid to the municipality based on air production and on the length of the distribution lines. The contract covering this arrangement expired in 1951, and has been renewed. The company, whose name has meanwhile been changed to Société Urbaine de Distribution d'Air Comprime, maintains two plants located on opposite sides of Paris.

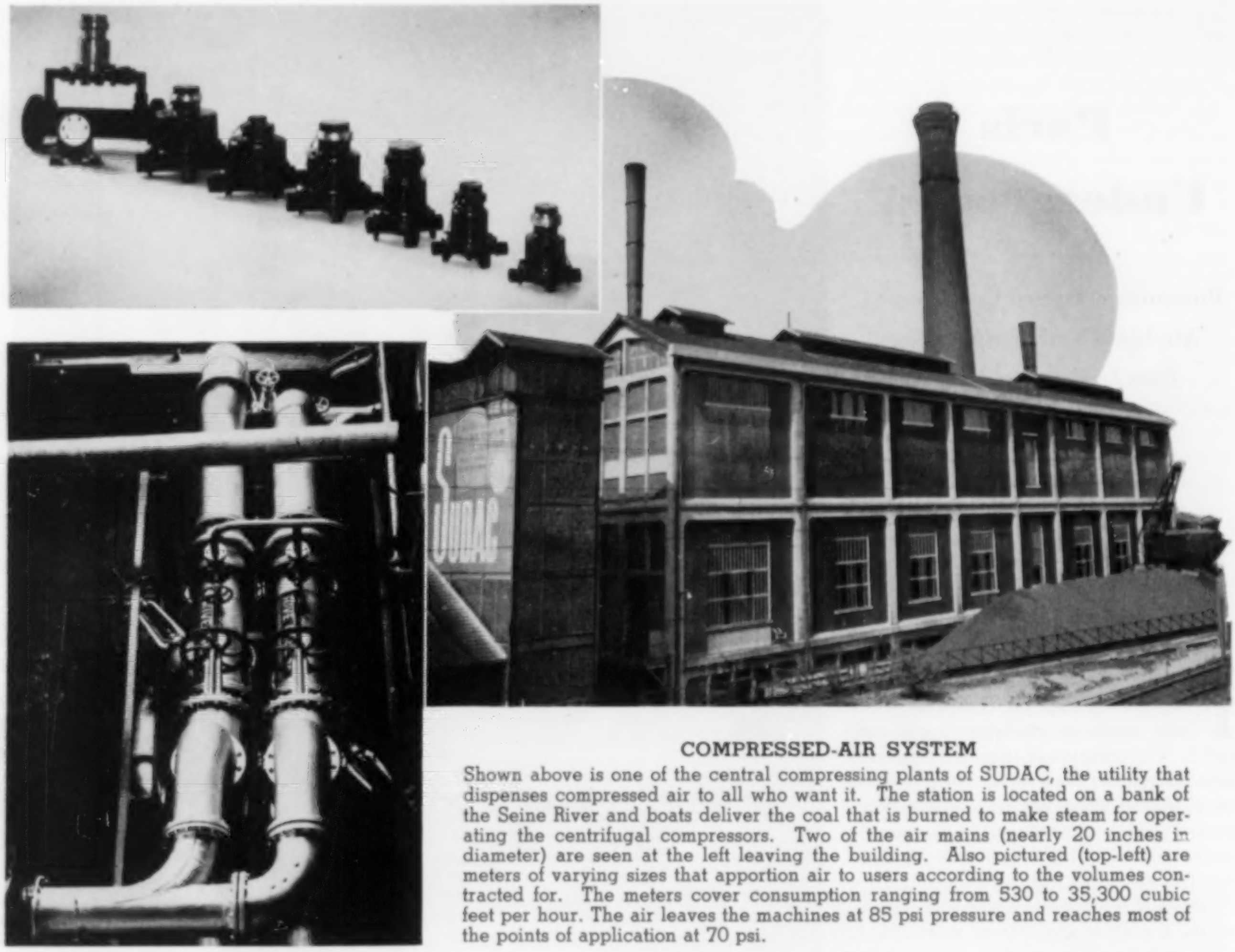


UNDER THE AVENUE

Architect's sketch of the service conduits under a typical main thoroughfare. Picture the confusion and congestion that would exist on the surface if these structures were not out of sight and out of the way. Included are water and gas pipes, electric cables, a Metro (subway) tunnel and two secondary sewers containing compressed-air lines, pneumatic tubes, etc. Note connections with the building on the right.

The main one is equipped with five centrifugal compressors driven by steam turbines and delivering 77,000 cfm at 85 psi. Steam is provided by seven Babcock & Wilcox boilers: six each producing 10 tons at 230 psi and 617°F, superheat, and one developing 16 tons at 360 psi and 752°F. A generator is mounted on the shaft of each turbocompressor to supply the plant with electric power. The other installation consists of two turbocompressors powered by electric motors. One delivers 7060 cfm and the other 14,120 cfm, also at 85 psi. A third unit with a capacity of 17,660 cfm is to be installed before the end of this year. Although the two plants are rated at 98,180 cfm, the maximum normal working capacity is 64,600 cfm because one unit is always shut down for maintenance and two machines are held in reserve to meet any emergency that might develop. At hours of peak demand, consumption is around 61,800 cfm.

Compressed air at 70 psi is delivered through 420 miles of piping ranging in diameter from 1⅝ to 20 inches. The main lines are from 8 to 20 inches in diameter and 45 miles long. Most of them are laid in the sewers and are therefore easy to get at. The oldest are of cast iron but are gradually being replaced by steel pipes. Condensate collects at low points in the system and is drawn off by means of automatic drain cocks. All



COMPRESSED-AIR SYSTEM

Shown above is one of the central compressing plants of SUDAC, the utility that dispenses compressed air to all who want it. The station is located on a bank of the Seine River and boats deliver the coal that is burned to make steam for operating the centrifugal compressors. Two of the air mains (nearly 20 inches in diameter) are seen at the left leaving the building. Also pictured (top-left) are meters of varying sizes that apportion air to users according to the volumes contracted for. The meters cover consumption ranging from 530 to 35,300 cubic feet per hour. The air leaves the machines at 85 psi pressure and reaches most of the points of application at 70 psi.

lines are coated with pitch, and welded gaskets are being substituted for old flange joints to reduce air losses to a minimum. Pipe expansion and contraction are an unimportant factor because the temperature in the sewers varies little.

With the exception of the hydropneumatic elevators, 4000 of which are still in service in Paris, the original air uses have been discontinued. However, the total number of customers has grown steadily by 500 a year—from 4400 in 1910 to 19,316 in 1951. During the same period air production has increased annually from 4624 million cubic feet to 10,625 million. This can be explained by the wide application of compressed air in all branches of industry.

At present air is being piped to many workshops to operate riveters, chippers, wrenches, hoists, paint-spray guns, and other pneumatic tools and equipment. It is also used for sandblasting, and many garages need it for inflating tires, washing cars and for lubrication. Before the last war, general contractors absorbed 10 percent of the total output for their cement guns, vibrators, paving breakers, etc., but many of them now have compressors of their own. Cafés and restaurants use air extensively to draw beer, and many plants take air from the underground system for ventilating and humidifying purposes. The cost is about one cent per 40 cubic feet of free air, with a progressively lower rate for large-volume consumption.

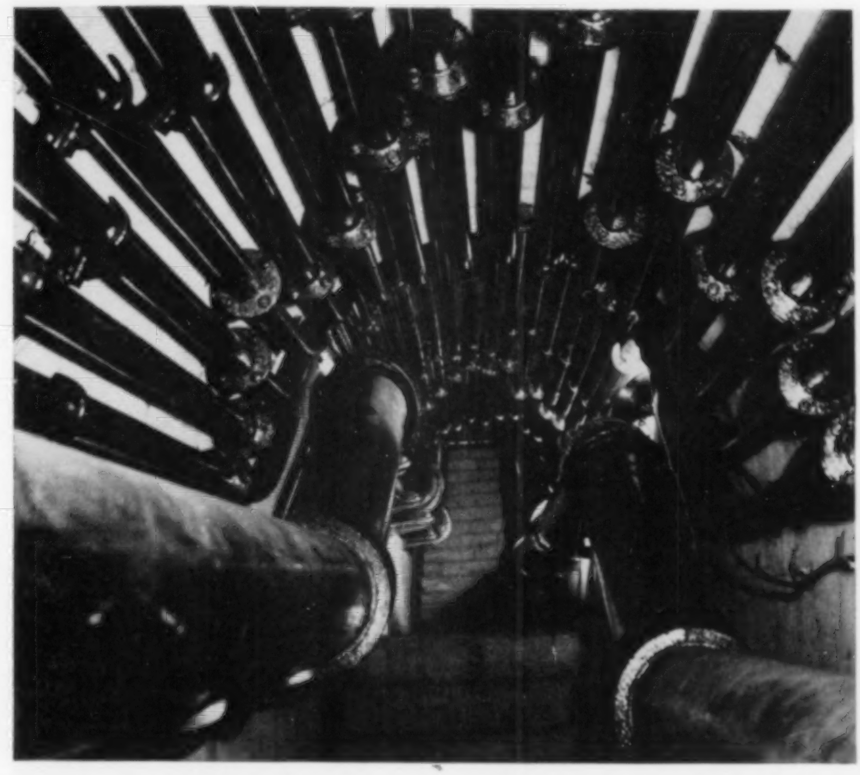
Pneumatic Mail-dispatch System

Paris owns and operates an extensive pneumatic-tube system for interoffice mail delivery. The installation, initiated in 1866, originally carried telegrams from post offices to central telegraph stations, but in 1879 it was greatly expanded so that special-delivery letters could be speeded from any one post office in the city to any other. The charge is not calculated by the number of words, as in the case of a telegram, but by the weight, and amounts to .45 franc (about thirteen cents) for 7 grams.

Today, the system serves all 129 Paris post offices and several ministries and carries yearly an average of 16,500,000 letters for delivery within the confines of the city, plus 7,000,000 telegrams to be sent beyond its environs from central telegraph stations. It is made up of 270 miles of pipe lines, 2$\frac{9}{16}$ or 3$\frac{3}{16}$ inches in diameter, most of which extend through the sewers where they are readily accessible.

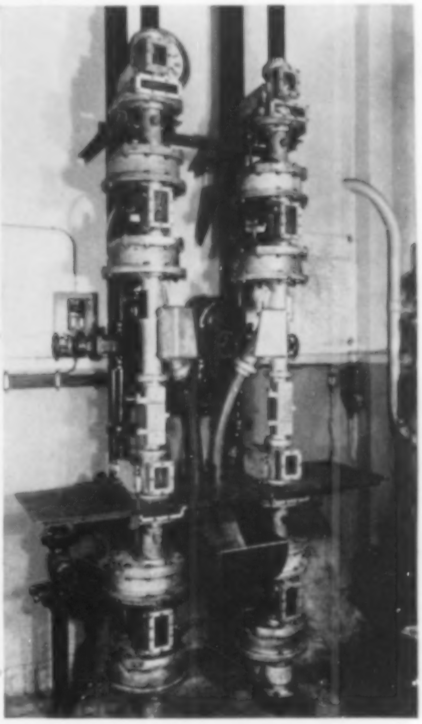
The mail is placed in special carriers which are pushed or drawn into the tubes by compressed air or vacuum produced in seven plants located at different points in the metropolis. Each, according to its importance, has two, three or four compressors and one vacuum pump, all of the rotary type to reduce vibration to a minimum. The vacuum pump draws air from the pneumatic system and exhausts to atmosphere, while the compressors take air from the atmosphere and send it into the pipe lines. Each compressor is driven by a 150-hp motor and delivers around 1300 cfm at a discharge pressure of 12 to 14 psi. Separators are used to free the air of moisture and oil vapors.

The seven plants are connected to fifteen main post offices by 18 miles of pipes with a diameter range of 4 to 12 inches, and the post offices, in turn, are interconnected by 20 lines 82 miles long and 3$\frac{3}{16}$ inches in diameter. In addition, they are linked with branch offices by 68 tubes 180 miles in length and 2$\frac{9}{16}$ inches in diameter. The lines are made up of 36-foot lengths of steel pipe usually with walls $\frac{3}{16}$ inch thick and joined by leather- or rubber-gasketed flanges to insure tightness. Each line consists of two paralleling tubes for 2-way traffic.



PNEUMATIC POSTMAN

Thanks to the elaborate tube network, a letter or telegram can be delivered anywhere in Paris within two hours after it has been deposited. The 270 miles of pipes that connect the 129 post offices carry more than 23 million messages annually. At the left is seen an array of pneumatic tubes entering one of the fifteen main postal depots. The large pipes at the bottom convey compressed air, which is introduced into the tubes at the dispatching station. One third of the system is equipped with apparatus (below) for automatically sending and receiving carriers.



The carriers are cylindrical in form and have a leather, plastic or metal cap on one end that is removed for the insertion of mail. To insure a tight fit and to prevent by-passing of the air that shoots the cylinders through the pipes, each has a leather gasket at the back. The large size is $2\frac{7}{16}$ inches in diameter, $5\frac{1}{8}$ inches long and holds about 35 letters; the smaller one has a diameter of $1\frac{7}{8}$ inches, a length of $5\frac{1}{8}$ inches and room for 20 letters. They are dispatched at intervals of five to ten minutes at an average speed of 1200 feet per minute.

Each post office is equipped with one receiver and one transmitter. Both hand and automatically operated equipment are in use, but the former, which necessitates stopping the flow of air in the whole line every time a carrier is withdrawn from the pipe, is giving way to the more modern means which permit automatic sending, selecting and ejection, as follows: First, the cylinders are introduced into the line by special apparatus without shutting off the air supply and are automatically transmitted at regular intervals; second, each stops only at the post office to which it is directed; and, third, when it reaches its destination it is ejected from the system into a basket without interfering with the air flow. At the present time, one-third of the entire system is equipped for automatic operation.

Each letter travels an average of 4.8 miles. By the old method it takes about an hour to cover that distance, and by the new one half as much. As soon as pneumatic-tube mail arrives at a post office it is distributed and, normally, a letter is delivered to the addressee anywhere in the Paris area two hours after the sender has handed it into the dispatching post office.

Central Heating System

As compared with other big cities, the Paris central heating system does not rank large. True, it was not put in operation until 1927, while New York, one of the 1220 communities in the world that use this means of heating, has been providing this service since 1882. At present the 18-mile Paris distribution network is supplied with steam at 200 psi and 450°F by three plants. Five hundred buildings are in the circuit, and the hourly heating capacity amounts to 250 million Cal (99,200 million Btu). On the basis of a 2000-hour working period, 800,000 tons of steam is produced every year.

The distribution mains vary in diameter from 2 to 28 inches and consist of two steel pipes, one carrying steam from and the other returning condensate to the plants. They are laid in special galleries or buried under the streets. For the time being, the system serves only the southeastern part of the city. It is inadequate, and there are plans to develop it in the near future.

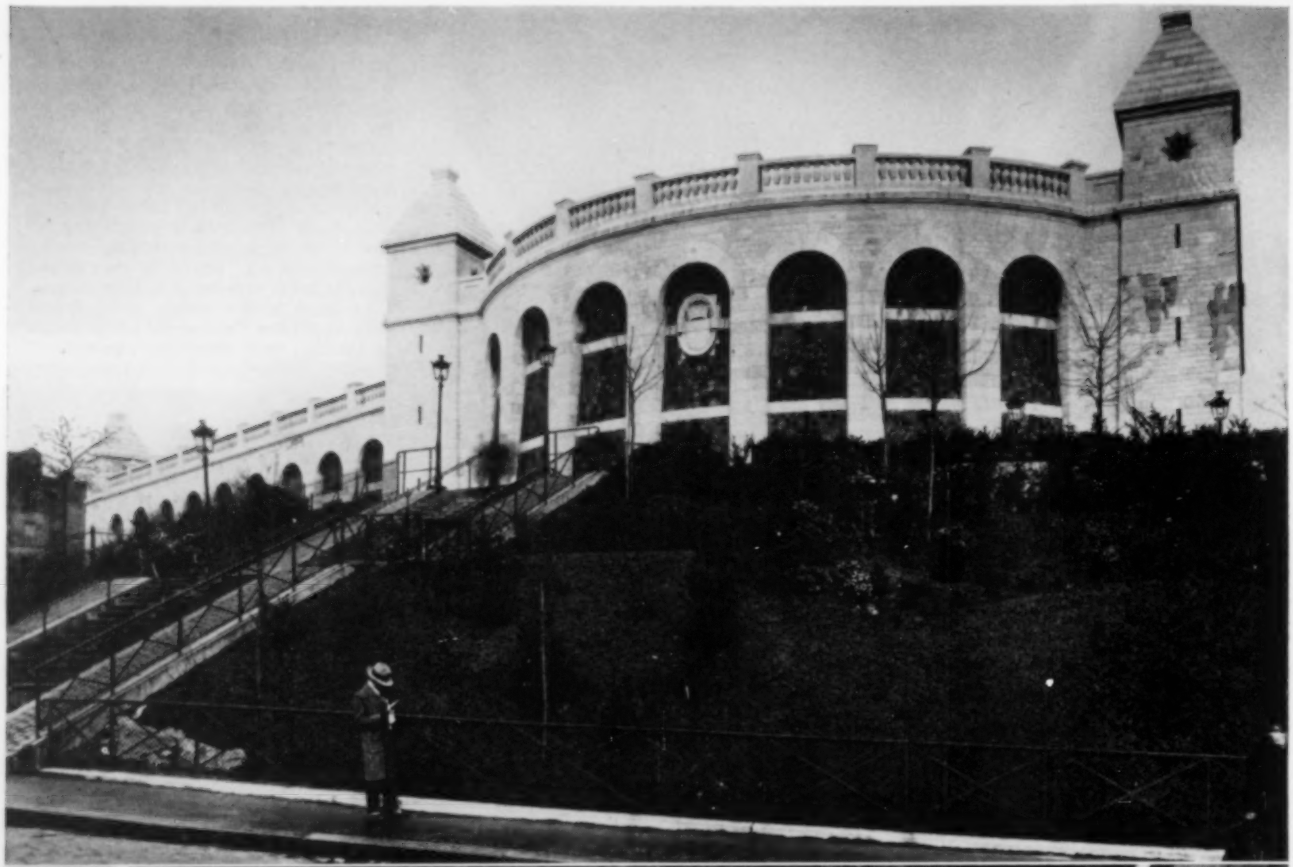
Gas and Electric Power

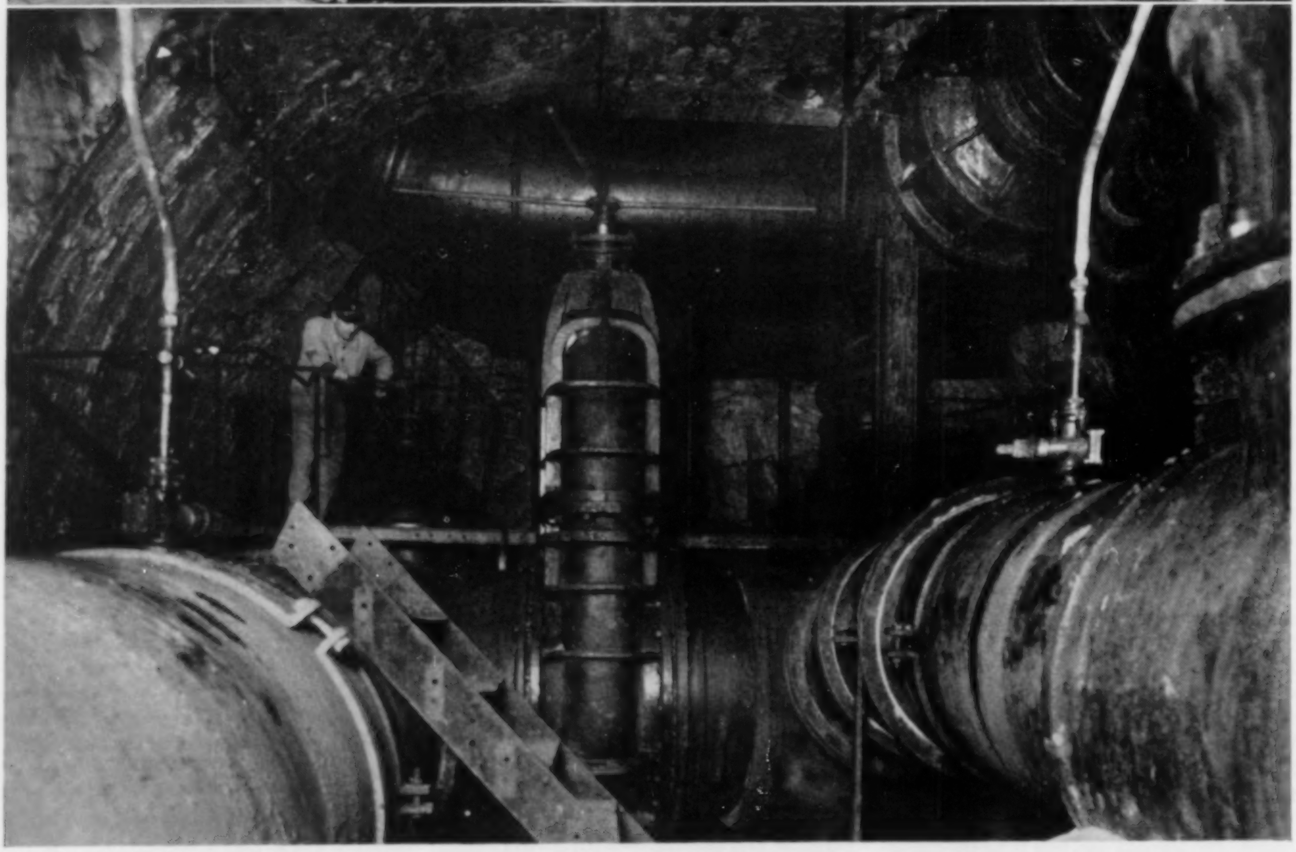
There are seven gasworks in the Paris area—four within the municipality and three in the suburbs—with a maximum daily output of about 105 million cubic feet. The main lines of the distribution network, which has a total length of 1600 miles, are of cast or rolled iron covered with pitch. They are buried beneath the sidewalks and are inclined sufficiently to allow drainage of the condensate. With the Paris underground the labyrinth it is, extra precautions had to be taken in laying the pipes in the neighborhood of power lines, sewers, subway tunnels, etc. Gas consumption rose from 20,000 million cubic feet in 1929 to 22,000 million in 1948.

Electric power is transmitted by armored cables buried in trenches or run through special concrete-lined galleries. The high-tension lines are placed at a depth of 4 feet and embedded in an 8-inch-thick layer of sand topped by two wire screens, while the low-tension cables lie 2 feet deep and have only one wire-net cover. On an average, the city uses current at the rate of 1500 million kwh.

Water-supply Systems

At the beginning of the nineteenth century Paris had a population of 550,000 and her daily per capita consumption of water was less than ½ cubic foot (under 4 gallons). The total daily supply, drawn directly from the River Seine and





WATER-SUPPLY FACILITIES

Scattered throughout Paris are eighteen reservoirs for storing water. Some contain purified drinking water, others untreated water from rivers and canals for industrial and miscellaneous uses. The top picture shows the exterior of a reservoir at Montmartre. Several large underground water mains and a control valve are seen at the bottom.

NOZZLES OF FOUNTAIN AT EIFFEL TOWER

Paris abounds with fountains, some of which are illuminated at night. Many of them are equipped with pumps that circulate the same water over and over.

a few wells and springs, amounted to 280,000 cubic feet (2,100,000 gallons) and was distributed among 455 private lines and 83 fountains. At that time Napoleon decided that the insanitary, inadequate method be abandoned for a new one, but nothing was done until 1854 when Haussmann, aided by Belgrand, laid the foundation for the present double distribution system, one furnishing drinking water and the other nonpotable water.

Now there are seven covered reservoirs at elevated points in the city where fresh water from springs and filtered and purified water from the Seine are stored for domestic consumption. Each serves a certain zone, but all are interconnected to meet the varying needs of the different districts. They have a total capacity of 26 million cubic feet. Water for industrial purposes, for street cleaning, sprinkling public parks, and for serving fire hydrants and fountains is pumped from rivers and canals into eleven tanks with a total storage capacity of seven million cubic feet. Some of these are uncovered. In addition, there are several storage reservoirs with two compartments: one, the lower, for impure water and the other for potable water. These are reserve tanks and feed water into any zone where the peak demand exceeds the local supply. Any excess fresh water can, if required, be pumped into the reservoirs holding nondrinkable water.

The two distribution networks have a combined length of 1881 miles: 974 miles of household lines and 907 miles for industrial and other uses. Most of them are installed along the side walls of the sewers and are made up of 12-foot sections of cast-iron pipe 1 to 6 feet in diameter. A few are of concrete laid in galleries, and 98 miles of old mains, buried in the ground, are still in use.

The entire water system is served by more than 32,000 valves and supplies around 110,000 buildings, plus 18,000 public outlets connected to both networks. In 1948, the latest year for which figures are available, consumption totaled 15,800 million cubic feet: 9900 million cubic feet of drinking water and 5900 million cubic feet of impure water. This represents a daily average per capita of 16 cubic feet, or approximately 120 gallons.

Escape and Other Tunnels

No story about underground Paris would be complete without mention of the numerous passageways that were dug long ago for varying purposes. Some, generally not more than a few hundred feet long and small in section, served occupants of houses as avenues of escape from their cellars. Others, like several under the Hotel Dieu, the oldest hospital in Paris, connected with the Seine and made it possible to deliver food and goods by small boats. There is also the Canal Saint-Martin which underruns the eastern part of the city for a distance of 1.2 miles and is open to navigation.

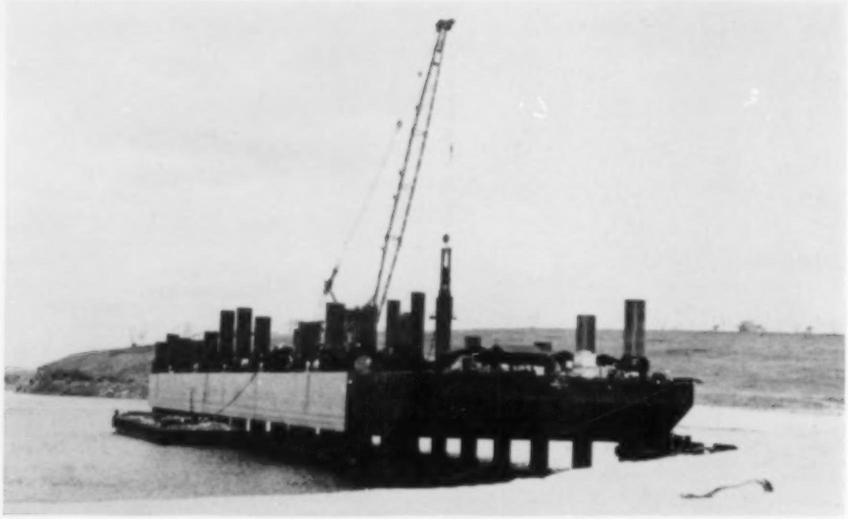
When tunneling for the sewers and Metro, workers came across galleries that had been excavated during the Gallo-Roman period. The supporting stonework was still in good condition. It is well-nigh impossible to determine the number and extent of the tunnels that were driven for private use, but anyone with an exploratory bent would no doubt discover several hundred of them under old Paris.

FRAMEWORK OF WATER CONDUIT

Workers lacing reinforcing steel in place preparatory to shooting concrete to form a large-diameter main for the water distribution system.

Barges That Turn into Piers

James Hirt



PIER SECTION AT LOCATION

The air jacks have lifted a barge out of the water and an air-operated hammer, suspended from the boom of a Manitowoc crane, is driving one of the caissons to a firm footing on rock. After being seated, the caissons were cut off flush with the deck, welded to the latter, cleared of mud by means of an air lift, tied to the rock by a concrete plug, filled with sand and then capped. Those of the dock section shown here averaged 95 feet in final length.

IT'S unusual to tow a barge 3000 miles, but it's even more unusual when that same barge converts itself into a dock standing clear of the water on 6-foot-diameter steel caissons. But that is exactly what has taken place on the Orinoco River in Venezuela where three such barges, each 376 feet long, 82 feet wide and 15 feet deep, have been connected to form a pier 1130 feet long at the iron-ore shipping station of the Orinoco Mining Company, a subsidiary of United States Steel.

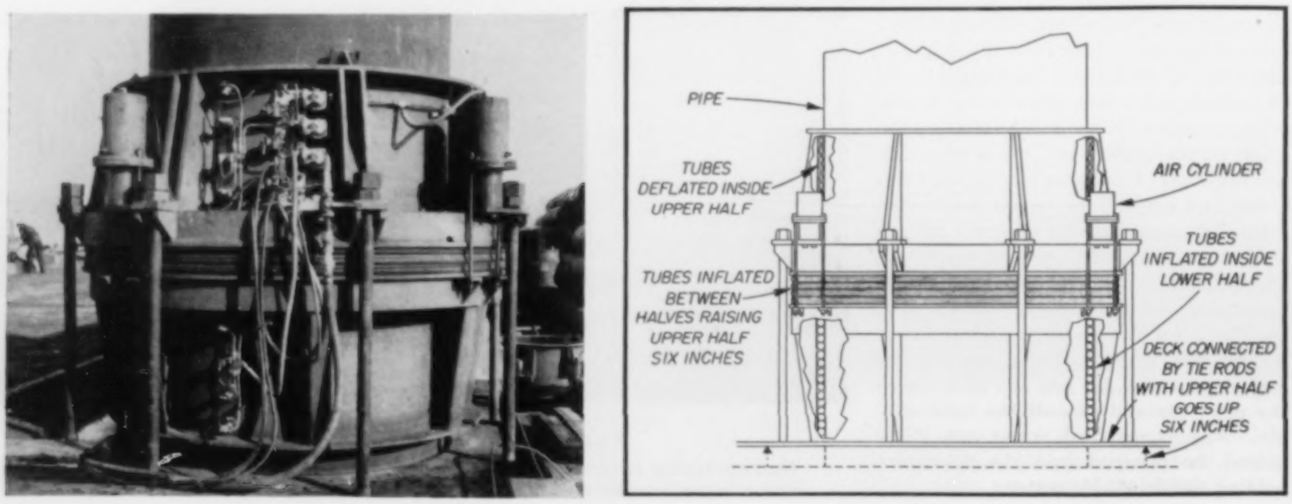
The big 2250-ton barges were fabricated in the yard of the Consolidated Western Steel Corporation, Orange, Tex., according to a design by Col. Leon B. DeLong, head of the DeLong Engineering & Construction Company, New York City, which was in charge of the engineering and construction of the docks. As soon as one was launched, it was floated across the Gulf of Mexico, the Caribbean Sea, through the Gulf of Paria and up the Orinoco River to Puerto Ordaz, Venezuelan terminal of the mining company. At the end of that journey the 100-foot-long caissons, firmly lashed to the deck of the vessel, were dropped through steel-faced wells in the structure. These openings were topped by special circular air jacks by means of which the barge climbed up the pipe columns to its permanent elevation safe above ocean tides and river flood level.

The key to the success of this new type of pier is the pneumatic jack, which was also invented by Colonel DeLong. One was installed above each of the 26 wells built into the barge to receive the caissons. Each consists of two parts made to fit loosely over the pipe. In the annular space between the latter and both parts of the jack are tirelike rubber tubes that serve as gripping members, while a similar group of tubes, which encircles the pipe between the jack sections, acts as a lifting member. The top half of the jack is bolted to steel tie rods that are fastened to the barge deck.

With the lower half of each jack positioned 6 inches above the deck, it was given a firm hold on the caisson by inflating its clamping tires. Then compressed air was introduced into the tubes between the two jack sections, thus

AIR JACK

The DeLong air jack climbs the pipe it surrounds in much the same manner as a boy "shinnies" up a tree. It is made up of an upper and a lower part, which may be compared to the boy's arms and knees, respectively. Inside each half and between the meeting edges of the halves are tirelike tubes. With the bottom section of the jack 6 inches above the deck of the barge, the tubes inside it were inflated to provide a firm grip on the pipe. Next, the tubes between the halves were inflated, raising the upper part and barge 6 inches. Then the tubes inside the upper section were inflated so that it gripped the pipe; those between the halves and inside the lower part were deflated; and the lower half was pulled up 6 inches in contact with the upper half by means of compressed-air cylinders. Because the top half of each jack was fastened with tie rods to the deck of the pier section, the latter was raised 6 inches every time the 26 jacks were operated in unison by manipulating a master air valve. The control was so sensitive that movements of as little as $\frac{1}{32}$ inch could be made, if desired. Air at 140 psi was used and supplied by two compressors.


PIPE
TUBES DEFLATED INSIDE UPPER HALF
AIR CYLINDER
TUBES INFLATED INSIDE LOWER HALF
TUBES INFLATED BETWEEN HALVES RAISING UPPER HALF SIX INCHES
DECK CONNECTED BY TIE RODS WITH UPPER HALF GOES UP SIX INCHES

raising the upper part, together with the barge, 6 inches. As soon as that was done the tubes in the top half were inflated to give it a grip on the pipe, all the other tires were deflated and two pneumatic cylinders, one on each side of the jack, pulled the lower half in contact with its mate to give the vessel another 6-inch lift. This cycle was repeated until the barge had been raised to the predetermined level.

The prefabricated steel barge is a hollow box structure subdivided for strength and safety into 148 compartments by three longitudinal and 38 transverse bulkheads. Some of the compartments between the skin of the vessel and the outer lengthwise bulkheads form the wells, of which there are thirteen on each side. Preparatory to towing the barge to the distant pier site, everything necessary for its erection—the caissons, a 100-ton crawler crane, air compressors and receivers, and other facilities—was loaded on board. The second and third dock sections also carried a tug, two 185-ton locomotives, ore cars and machinery and equipment for use at Puerto Ordaz. At the time of construction, each unit was equipped with piping for oil and water, mooring devices and tracks for a traveling crane and ore-loading conveyors.

Upon arrival, each vessel was first moved into approximate position, the deck was cleared of miscellaneous cargo, and the crawler crane picked up the caissons and lowered them through the wells, where they were held temporarily by the jacks. Next the barge was maneuvered into final location, the jacks were released, and the caissons allowed to sink under their own weight through the sand overlying the rock bottom. Because they weigh about 40 tons each, they readily penetrated the loose material. They are made up of ten 10-foot sections and have a wall thickness of 1 inch.

Thus anchored, the barge then proceeded to lift itself out of the water. Step by step the jacks enabled it to climb up the pipes to a height above low water level where it will be well out of harm's way of the 40-foot flood stage often experienced at Puerto Ordaz. All the jacks were operated simultaneously through the medium of a master control system which permitted making adjustments up or down of as little as $\frac{1}{32}$ inch to maintain proper alignment of the vessel at all times. Two compressors supplied air at approximately 140 psi to the system, which was designed so that it was virtually impossible for those in charge of the work inadvertently to drop the barge, nor could the latter drop of its own accord in the event the compressors or piping failed. The jacks also could be controlled individually, if necessary.

When the barge reached the desired height, the jacks were released one at a time and the caissons driven to refusal about 10 feet below the sandy bottom by a crane-mounted air hammer. As soon as one was in place, its jack was again engaged and the hammer shifted to the next one. Finally, when all were in position they were tack-welded to the dock section, the jacks were removed, excess pipe lengths were cut off at deck level, and loose material such as sand and rock was blown out of the supporting columns by an air jet. Then each one was firmly tied to the rock by an 8- to 10-foot concrete plug, filled with sand, and the top sealed by welding on a steel plate. All caissons on the shipside of the pier were pinned to the rock with heavy steel angles. This anchorage was not required in the case of the inshore caissons which have a footing in deeper sand and are not subjected to the impact of docking ships.

To make the barges seaworthy for their journey, they had to be watertight, a condition that was undesirable once they were converted into a pier. Holes were therefore cut into the structure to permit the water to surge through freely when the Orinoco rises to flood stage and thus prevent it from exerting heavy and possibly damaging pressure against the bottom and sides.

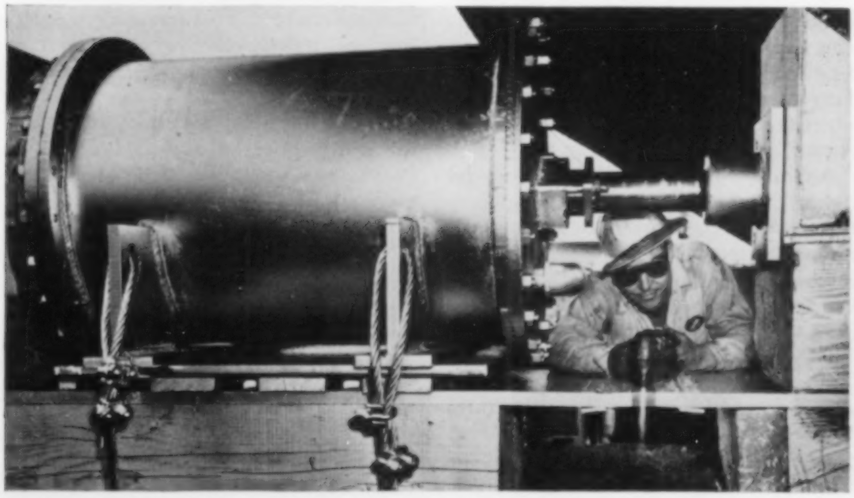
To span the distance between the dock and Cerro Bolivar, where the iron mines are located, the company is building a railroad and a highway. At Puerto Ordaz, the ore from the workings will be transferred to carriers for shipment to the United States Steel's Fairless Works near Morrisville, Pa., on the Delaware River, as well as to ports for transhipment to its Alabama and Pittsburgh district mills.

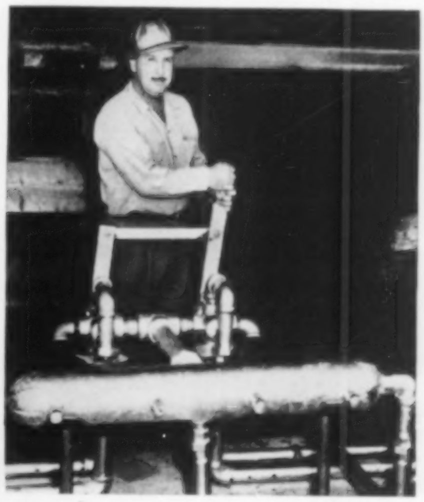
The practicability and ruggedness of the DeLong prefabricated dock, which can be towed to out-of-the-way locations and there lift itself to whatever level conditions may dictate, has been proved by several installations. One of these, in the Arctic, has been in use for more than a year and has successfully withstood the buffeting of wind, waves and ice. Perhaps its greatest advantage, as compared with conventional structures, is the reduction in the amount of field work and labor required and the speed with which it can be erected.

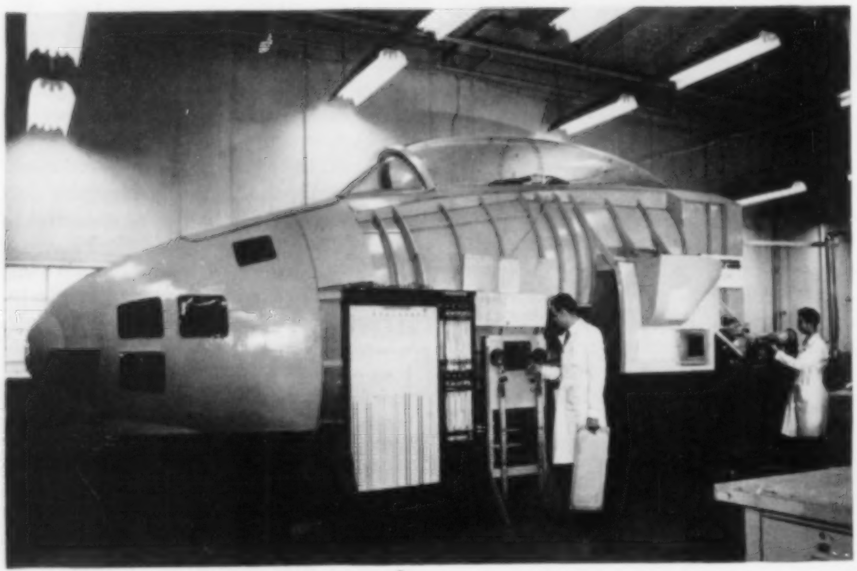
LAUNCHING DOCK SECTION

Each barge was built on keel blocks and cribbing placed between inclined shipways, with the bow at the high end. Preparatory to launching, the ways were greased and wood cradles resting on them were fitted snugly under the bow and stern and tied together with transverse steel beams. Each of the upper cradles was moored to the solid back wall of the way structure by a 1-inch steel plate. When the moment of launching arrived, two "burners" with acetylene torches began simultaneously to sever the plates, and when they were parted the craft usually started sliding down of its own weight. But for use if needed, a large air cylinder was mounted at the top of each way, with the piston in a position to give the cradle a shove. The picture at the left shows R. G. McLean under a piston leaning on and cutting one of the plates. Meanwhile, D. H. McDermott, marine-ways superintendent, right, was ready at the control valve to admit air to the cylinders in case their services were required.

PHOTOS, COURTESY "U. S. STEEL NEWS"







MOCKUP FOR RESEARCH

Replica of B-47 Stratojet nose, left, used for trying out mist-eliminating equipment. Compressed air and steam were used to simulate atmospheric conditions met during actual flights at various altitudes in different climates. Below is a view through the windshield of the mockup that shows fog resulting from a difference in temperature of the cabin air and that introduced from outside. The cloudiness disappeared when the entering air was dehumidified.

Taking the Fog Out of Jet Planes

Compressed Air Helps Boeing Engineers Design Equipment for Removing Moisture from Cabins

John Starr

"I CAN fly over, under, or around bad weather if it's outside. But when it rains and snows right in my cabin, what can I do?" This was the often-voiced query of jet pilots that engineers of the Boeing Airplane Company, of Seattle, Wash., were recently able to answer with the assistance of compressed air.

Classed as a nuisance at first, the problem became especially acute when jet planes started to penetrate the sonic barrier at altitudes ranging from sea level up to the substratosphere, and it was perplexing for many reasons — most important of which was the simple fact that the conditions never seemed to occur with any degree of consistency. They came and went, so to speak, like rabbits in a magician's hat.

"When we began our investigations," said Boeing engineer Bob Walker, "we knew very little other than that our problem was a matter of air conditioning. Why? Because we realized that the phenomena in question could be attributed only to atmospheric conditions, many of which may be encountered in rapid succession by a jet in the course of any flight. For example, starting out near sea level, where it may be very warm and humid, the plane may shoot in a few seconds to a high altitude where it is very dry and cold. And when the time comes to land, these conditions are reversed, of course."

A Boeing test pilot, who took a jet aloft on a high-humidity summer day has given the following vivid description of what happened: "Large amounts of snow, ice, water and fog were expelled from the air-conditioning vents at various heights. A serious situation developed when appreciable quantities of water poured from the vents on to electrical connections, relay boxes, etc. In landing, water also ran down the inside surfaces of the windshield, impairing vision because the moisture could not be removed by outside wipers. Still another danger was encountered after landing, when the air inside the cabin suddenly turned into a thick pea-soup fog."

An analytic study of the report on the test flight enabled Boeing engineers to ascertain the most likely causes of the phenomena. For instance, it seemed reasonable to suppose that the fog was due to the warm, moist air introduced into the chilled cabin upon alighting. This would quickly raise its dew-point temperature to its dry-bulb temperature, a situation which, if it existed in nature, would lead meteorologists to predict foggy or cloudy weather. However, all theories had to be carefully proved or disproved, and that was done by using compressed air and steam to simulate actual flight conditions in a cabin mockup of a jet-propelled bomber. And that wasn't easy.

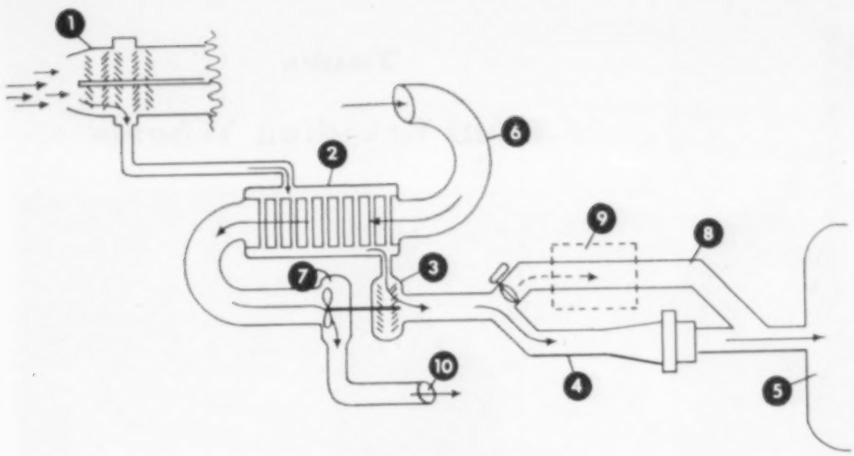
It was necessary, for instance, to reproduce the temperatures of an Air Force "summer day" and a National Advisory Committee for Aeronautics "standard day," with the corresponding, assumed humidity. These "days" represent specific atmospheric conditions used for laboratory work. Both are relatively humid, and their values at sea level are as follows:

NACA standard day: outside air temperature, 59°F; relative humidity, 100 percent; moisture content, 75 grains of water per pound of dry air.

AF summer day: outside air temperature, 100°F; relative humidity, 33 percent; moisture content, 100 grains of water per pound of dry air.

Both occur every summer throughout the central United States, the central Pacific, the Philippines, the Mediterranean, Borneo and northern Australia. But in India, around the Panama Canal, in the Caribbean, Louisiana and Florida, where the air reaches higher temperatures and therefore holds more moisture, there are days when the humidity is even greater.

According to Bob Walker: "No matter where or under what circumstances the problem arises, there is no question that too much moisture is entrained in the air drawn into the cabin from the



SCHEMATIC DIAGRAM OF SYSTEM
Flow of compressed air used to increase pressure in a plane cabin during high-altitude flights, showing steps taken to remove moisture and thus eliminate formation of fog and ice in plane interior. 1- Turbojet engine compressor. 2- Heat exchanger for cooling compressed air. 3- Air-cycle expansion turbine for further cooling the air. 4- Air-moisture separator. 5- Airplane cabin. 6- Cooling-air inlet duct. 7- Turbine-powered fan for exhausting cooling air. 8- By-pass line around separator. 9- Proposed location of ice separator (to be developed). 10- Overboard vent for cooling air.

outside. We therefore knew that we could lick it by taking the moisture out of the air before blowing it into the fuselage."

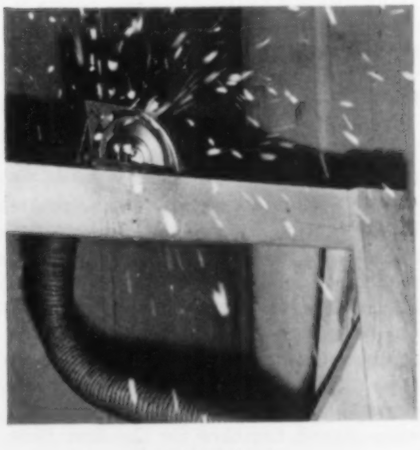
It must be remembered that the air-conditioning systems of high-altitude planes depend on compressed air to maintain near-sea-level pressures in their cabins when climbing to rarefied heights. The heat generated in compressing this air necessitates the use of air coolers so that the temperature can be kept at a comfortable level. As the reach of aircraft increases, the relative value of pressurization and cooling increases, and this aggravates the condensation problem. In short, there is need for extracting moisture from the air in present-day aircraft, but it will be even more vital to do so in planes of the future.

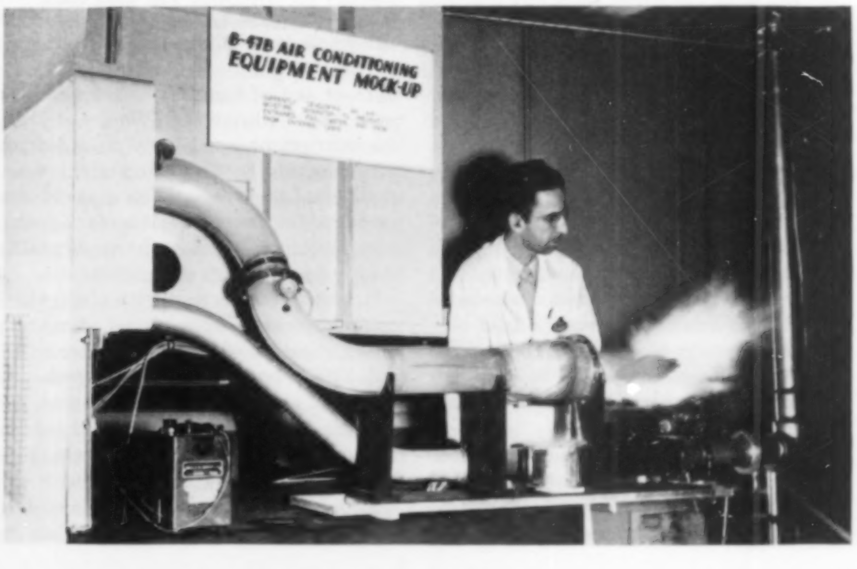
Three general types of water separators were considered: centrifugal—helical, cyclonic, impeller and hopper; condenser—water spray, heat exchanger, bubble bath and Venturi; and collector—momentum and electronic. Of course, some of these are not readily adaptable for aircraft use because of their bulk, weight and other considerations. Boeing chose what seemed the likeliest one, and began its development work from there. A combination helically shaped vane inside a duct and a water trap were first tried but with slight success. Next an impeller, consisting of a cone-shaped hub with spiral vanes, was tested. Whirling inside a duct, the vanes deflected the onrushing air and threw the entrained water onto the inside surface of the duct. This unit was moderately efficient, but not enough to free the cabin from excessive moisture.

"We kept on making impellers of different shapes, but none was much of an improvement over the previous ones," stated Bob Walker. Finally, a unit with a cyclonic rotor attached did the trick. Oddly enough, this combination seemed so unpromising when first run in dry air that the engineers were inclined to throw it aside. However, when moisture was introduced into the air stream, the cyclonic impeller literally gushed with water. It was a lucky shot: the seemingly no-good separator was found to be approximately 80 percent efficient. That was adequate, for with 100 percent efficiency there might be danger of damaging the occupants' lung tissues because of a lack of moisture in the air. The 20 percent residue serves another useful purpose; by evaporating, it cools the cabin considerably, supplementing the air-cooling system.

A valuable addition to the impeller is a trap of brand-new design for catching the water after it has been thrown against the inside wall of the duct and for leading it away. In its final form, the separator is light in weight, the entire assembly weighing not more than 4 pounds.

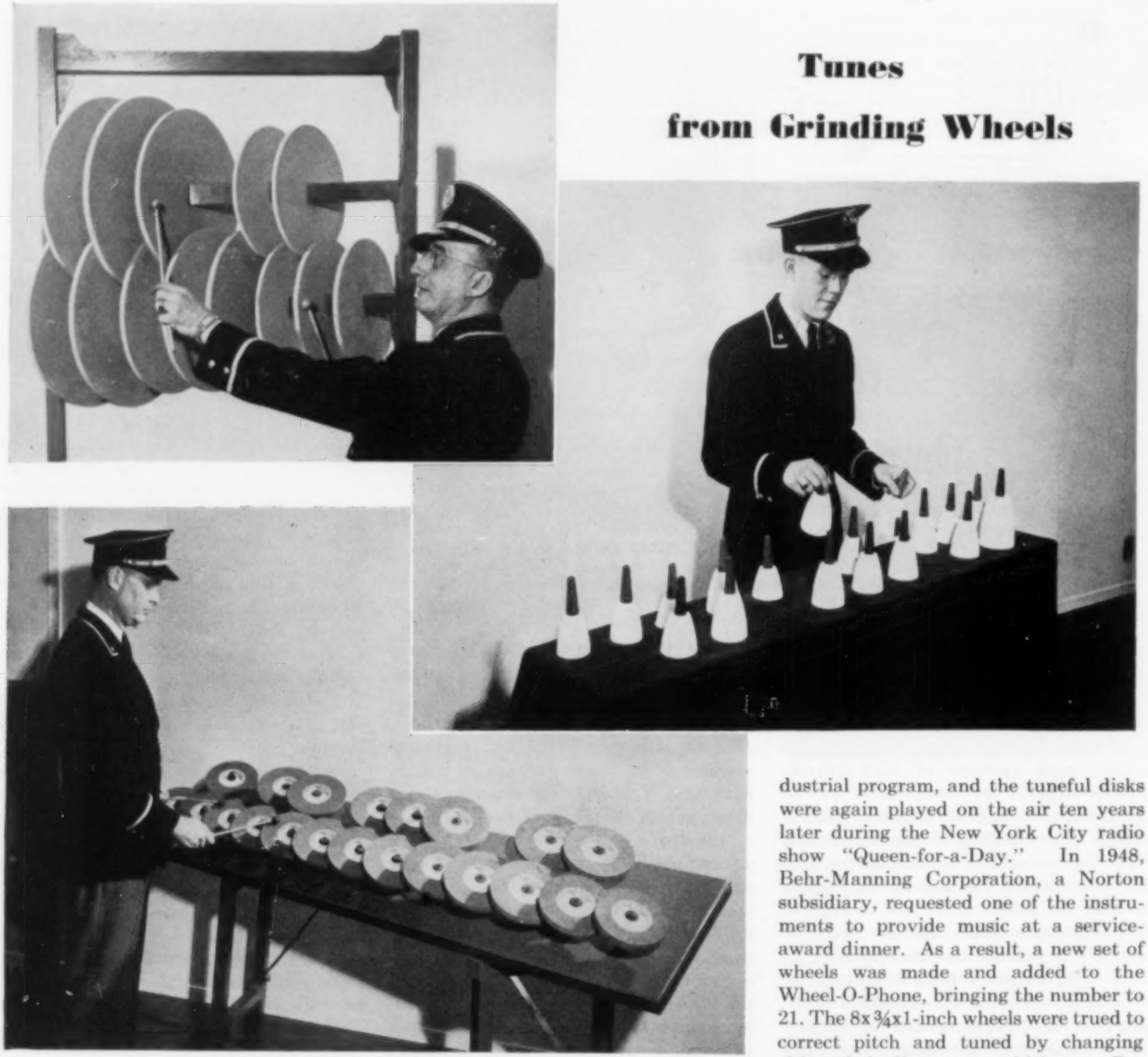
With the moisture problem of today's jets thus solved, there is still the matter of snow and ice. The unit works like a charm so long as the air flowing through it is no colder than 33°F, and under most conditions it does not get colder. But in some high-flying planes the air-conditioning systems operate under considerably higher pressures, and this circumstance, accompanied as it is by greater expansion of the air as it passes through the separator into the cabin, will bring about lower duct temperatures and cause snow and ice to form. "We are working on that problem now," says Bob Walker, "and we think we know how to solve it."





FOG AND ICE
Plume of fog, right, emerging with a stream of compressed air from an early model of the "Gushing Gertie" moisture separator. Bob Walker, who devised the apparatus, is holding a hand in the stream. When certain lofty flying conditions were duplicated, ice particles showered from an air duct, as pictured above.

Tunes from Grinding Wheels



MELODIOUS ABRASIVES

Three instruments made from Norton grinding wheels that have been played at company affairs or on the radio. Just above is the latest version of the "Wheel-O-Phone," consisting of twenty-one 8-inch wheels. The "Wheel-O-Chimes" (top) is composed of thirteen Alundum wheels of varying sizes commonly used for grinding glass. Eighteen refractory crucibles designed for laboratory use were fitted with handles and clappers to transform them into "Cruci-Bells" (right). Handles were made of different materials to distinguish whole from half notes.

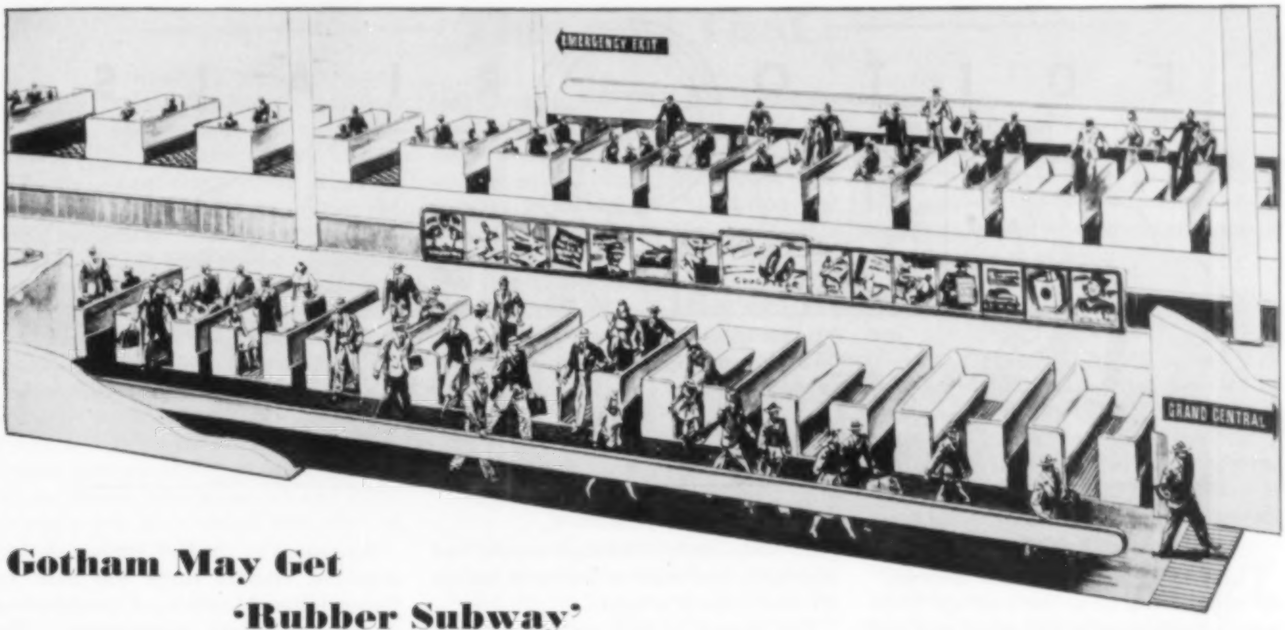
MUSICAL instruments made from grinding wheels are a novelty developed by Norton Company, Worcester, Mass. There is no thought of putting them on the market, but during the past 40 years at least four different ones have been built and played on special occasions. Like fine china, vitrified, bonded abrasive wheels emit clear, bell-like tones when tapped with a solid object. In fact, a wheel's soundness and grade of hardness are partly determined at Norton by the clarity of the tone they produce when so struck.

It was only natural that someone should assemble a group of wheels of different sounds into a musical instrument. That was first done in 1911, when eight or ten of the disks were mounted on a stand. Christened Wheel-O-Phone, the instrument was played at a Norton sales meeting to demonstrate the tonal qualities of the wheels. The next one was produced fourteen years later for another sales conference to show the applicability of sound as a means of grading.

It was in connection with these studies and research work aimed at making better grinding wheels that Norton "B" and "BE" bonds were developed. In addition, electrical apparatus was put into use for measuring the pitch of the ring emitted by grinding wheels, thus facilitating grading.

About 1937, a Worcester radio station used a set for musical effects on an industrial program, and the tuneful disks were again played on the air ten years later during the New York City radio show "Queen-for-a-Day." In 1948, Behr-Manning Corporation, a Norton subsidiary, requested one of the instruments to provide music at a service-award dinner. As a result, a new set of wheels was made and added to the Wheel-O-Phone, bringing the number to 21. The 8x¾x1-inch wheels were trued to correct pitch and tuned by changing either their diameter or thickness. Resembling a xylophone, the assembly consists of a wooden frame supporting 21 slightly inclined spindles upon which the wheels are mounted with rubber bushings.

Two other instruments, the Cathedral Wheel-O-Phone and the Cruci-Bells were then developed. The latter is made up of a collection of eighteen pure oxide refractory crucibles used in laboratories and similar in design to the metal bells played at Christmas by bell ringers. The handles are Norton mounted points with red Alundum abrasive indicating whole tones and Crystolon abrasive for half tones. The clappers are molded Norace cement. In 1948, the three instruments were played together for the first time in public at the Worcester Memorial Auditorium. A fourth instrument, the Wheel-O-Chimes, is composed of thirteen Alundum wheels of varying sizes commonly used for grinding glass. When they are tapped lightly, tones are emitted that sound much like those of church bells.



IT'S ALL DONE WITH BELTS

Artist's conception of loading and unloading (foreground) platforms of belt-line railroad, on which 10-passenger cars would move in a continuous stream.

Gotham May Get 'Rubber Subway'

A MOVING sidewalk, the dream of lazy men for years, may become the basis of New York City's newest and most economical transit line. Before the City Planning Commission there is now a bill providing for an appropriation of $3,800,000 to substitute a rubber belt conveyor for the existing 34-year-old shuttle subway beneath Forty-second Street between Grand Central Station and Times Square.

The shuttle was installed in 1918 as a temporary means of connecting the east- and west-side subway lines, but since that time it has become an important crosstown link in the city's underground transit system. Carrying more than 60,000 passengers each day, it is greatly overtaxed by morning and afternoon peak loads which result in congested platforms and waits for individual trains to stop, load and move on again. Aboveground the situation is similar. Vehicular traffic has reached the saturation point, and is further impeded by crowds of pedestrians.

To increase the capacity of the shuttle sufficiently to relieve the situation would involve a large capital expenditure for new or enlarged tunnels and the necessary track and rolling stock. But even that would not eliminate intermittent overcrowding of the platforms between trains. The proposed belt conveyor would solve the problem because it would permit sending a steady stream of 10-passenger cars past the loading platforms at an average rate of 25 per minute. Furthermore, it could be fitted into one-half the space now occupied by the shuttle, leaving two 20-foot strips for expansion. Under present plans these spaces would become lighted, ventilated bomb shelters and walkways, to that extent reducing pedestrian congestion aboveground.

The new system would necessitate straightening the existing tunnel and modifying the extrances so as to channel entering and exiting riders into one-way walkways that would prevent jams and confusion. The cost of the undertaking, not including tunnel changes, would be about $700 per foot. It is claimed that maintenance would be less than half the $375,000 now spent yearly. In addition, most of the noise and dirt of the present installation would be eliminated.

Passengers would enter the cars by first stepping onto a platform running parallel to them at the rate of 1½ miles per hour, which is about half normal walking speed. From the platform the riders would step directly into the cars, also moving at 1½ mph. As each car cleared the end of the loading platform it would pass on to banks of rubber-tired wheels which would increase its speed to 15 mph for delivery onto the main belt.

At the other end of the line these stops would take place in reverse order, with the car decelerating to 1½ mph and the passengers alighting onto a moving platform before finally stepping off at the terminals. The estimated time for the trip from loading platform to unloading platform is 2¾ minutes. The system could handle 15,000 seated passengers an hour in each direction. As a car is unloaded it would clear the platform, run onto a turntable and be transferred to the belt heading in the opposite direction, thus completing the circuit.

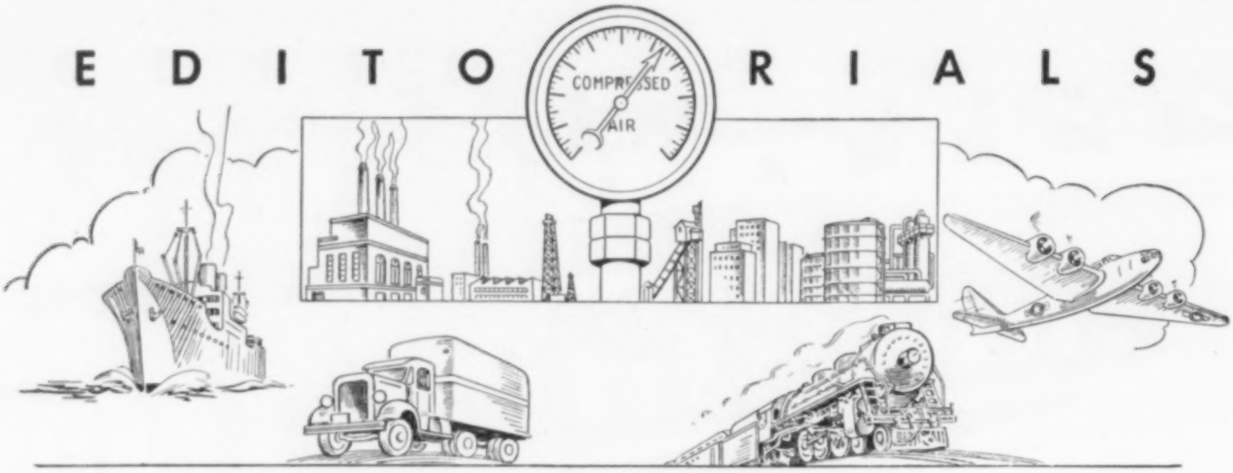
Initial engineering work on the project was carried out by the Goodyear Tire & Rubber Company and the Stephens-Adamson Manufacturing Company and is based upon ideas advanced by Sidney H. Bingham, chairman of the New York City Board of Transportation and traffic consultant for other major American cities. During World War II he supervised train unloading operations at the Normandy Beachhead and commanded the rail network in Europe for our Armed Forces.

At Akron, Ohio, Goodyear designed and built a 68-foot-long conveyor sidewalk and experimented with it for a year to determine the practicability of such a transit system and the highest safe operating speed. All kinds of tests were made with passengers carrying hampering bundles and even with women wearing shoes ranging from sandals to French-heeled pumps. Vibration shock induced under varying conditions was measured, and it was found that a heavy woman with spike heels on her shoes would receive the greatest shock. The engineers say that a 1-inch-thick belt, which would be needed to handle the Grand Central-Times Square traffic, would last from 20 to 30 years.

An installation based on the same principle as the New York system has been recommended for Cleveland, which is now engaged in building a 13-mile east-west rapid-transit line. It would operate between the Terminal Tower station and Playhouse Square, a distance of 3300 feet, but would incorporate two intermediate stops for loading and unloading passengers.

In addition to the applications already cited, Mr. Bingham visualizes others for the rubber passenger conveyor, including moving sidewalks at airports, parking lots, racetracks and even supermarkets. One of its first and probably most feasible uses may well be the transportation of pedestrians over and under busy street intersections.

EDITORIALS



ROSY FUTURE FOR MINING

JUST as "money makes the mare go," so do metals make the world go. Until man learned to mine and smelt ores and work the resultant metals into useful shapes, he was a sorry creature, indeed, living on a plane little higher than that of wild animals. Now we have reached a stage where metals have replaced wood in part for numerous traditional applications. Even metal houses are making a bid for public approval.

Not so long ago a quartet of metals—iron, copper, lead and zinc—took care of most of our needs. Today the list of those used commercially is long. Even laymen handle and are familiar with aluminum, nickel, tin and chromium. Manganese, magnesium, molybdenum and tungsten are yet to reach that category, although they are important industrially. Titanium, thorium and uranium are much in the news these days, but how many persons have actually seen either the metals themselves or the ores from which they come? Then there are antimony and bismuth, barium, beryllium and boron, cobalt and cadmium, columbium, gallium, germanium and so on through the alphabet to zirconium. All are emerging fast from the status of laboratory curiosities.

In fact, the whole group, from the old stand-bys to the strange new ones, are in brisk demand. After a thorough study, the President's so-called Paley Commission reported that an unprecedented two-billion-dollar expansion program is in progress in the United States mining industry and predicted that by 1975 production of minerals will exceed current output by 90 percent. As regards individual metals, the report foresees increases in demand ranging all the way from 18 percent for tin to 324 for titanium and cadmium, 344 for cobalt and a stupendous 1845 for magnesium.

The curve of the rising production will, however, most likely be indented by numerous peaks and valleys. Even now the trend of prices indicates that the urgent call for lead and zinc has abated, at least temporarily, although copper and aluminum and most of the rarer metals are still eagerly sought.

The impact of this great long-range appetite for metals will be felt in many ways. Already it has sent geologists scurrying to the far ends of the earth to search for new ore bodies, and some of the results may be seen in the huge mining-development programs that are now underway in Canada, Venezuela and the Belgian Congo. It has also served to stimulate the lagging interest of young men in a mining career. Mining engineering schools report a significant rise in enrollment for the fall term. At Montana School of Mines, for example, freshman registration is up from 80 in 1951 to 134 this year. Starting salaries for graduates have been increased, although moderately. A young man can still make as much as a laboring miner as he can as a bottom-of-the-ladder engineer, but the technically trained youth will have plenty of opportunity to climb fast if the future is half as bright as it promises to be.

HUNGRY HORSE DAM

THE WEST has recently put another imposing dam to work. High in the mountains of Montana, on a tributary of the mighty Columbia River, the quaintly named Hungry Horse barrier was dedicated on October 1, although the first of the four 71,500-kw generators its power plant will eventually house already had been whirring for a few weeks. Three days after the ceremonies the last of the structure's 3,100,000 cubic yards of concrete was placed, almost a year ahead of what had been considered a rather "tight" construction schedule.

Beginning on September 7, 1949, the 564-foot-high arch on the South Fork of the Flathead River grew at a near-record pace. At the peak of pouring in 1951, with a single mixing plant in service, 9000 cubic yards was put in place in one day, 235,650 cubic yards in one month, and a monthly average of 206,000 cubic yards was maintained throughout half the year.

Sponsored by the U.S. Bureau of Reclamation, Hungry Horse was built by General-Shea-Morrison, a combination of twelve western constructors. The contract for $43,431,000 was the largest ever awarded by the Bureau. The total cost, including power and irrigation appurtenances and the 34-mile-long reservoir, will approximate $100 million.

The dam will bestow varied benefits on the arid, power-short Northwest. Aside from the electric energy its generators will produce, it will add to the capacities of ten other plants now in operation or being constructed downstream by storing for later liberation 3½ million acre-feet of water that would otherwise flow to the sea during the high runoff months of May and June. Multiple use of this water will add a maximum of 810,000 kw to the output of the Columbia's generating system, according to the Bureau.

Most of the 285,000 kw of energy that will be issuing from the Hungry Horse generators by November, 1953, has already been spoken for. The new phosphate plant of Victor Chemical Company at Silver Bow, Mont., and the projected aluminum refinery of Anaconda Copper Mining Company near Kalispell, Mont , will take around 200,000 kw and Montana Power Company also will be a customer. By the time all the power has been put to work, industrial jobs for 47,000 people will have been created, the Bureau estimates.

Equally important agricultural benefits will accrue. Within ten years irrigation will be available to from 40,000 to 85,000 acres in a section that now receives an average of only 6.73 inches of precipitation annually. Only 3 percent of Flathead County, which is larger than Connecticut, is now in crops.

Majestic Hungry Horse Dam is the third-highest river barrier in existence, and the concrete in it would build a standard highway 20 feet wide and 1750 miles long. It is only 12 miles from one entrance of Glacier National Park, whose 300,000 annual visitors will now have another work of grandeur to look at.

This and That

Auto Cooler Ready

General Motors Corporation has developed a successful air-conditioning unit for automobiles and will probably introduce it next year as optional equipment in Cadillacs and Oldsmobiles. It has been tested for several years in the dry heat of Phoenix, Ariz., as well as in humid areas elsewhere. It is claimed that a car that has been standing in the sun can be cooled to a comfortable temperature by the time it has gone six blocks. The system uses Freon as a refrigerant. A rotary compressor is mounted on the car engine, and the condenser, circulating fan and other elements are in a sealed unit that is placed in the trunk.

* * *

Goo Meets Match

Du Point is selling a new paint at $75 a gallon, or at about 29 cents a tablespoonful, and expects the demand for it to be brisk. It is a polytetrafluoroethylene finish called Teflon, and the material is said to provide a surface to which practically nothing will adhere. Consequently, it promises to end the need for greasing bread or muffin pans in bakeries and to prevent such sticky substances as ashesives, candy, powdered soap, rubber, etc., to cling to processing and manufacturing equipment.

Teflon is a water suspension of a du Pont plastic that possesses high resistance to chemicals, heat and moisture. It is so expensive to produce that there is little likelihood of its ever becoming a consumer product, but householders will perhaps benefit by it through applications to such things as rolling pins, pans, funnels and measuring cups. It is already being applied to heating units that seal wrappers of frozen foods.

* * *

Novel Use of Air Blast

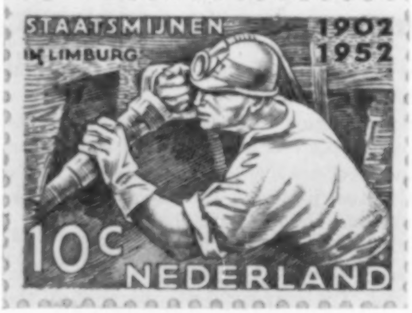
A new kind of concrete roof developed by the Ohio Lift-Slab Company, of Cleveland, Ohio, is called the "waffle type" because it has a regular pattern of deep indentations to reduce its weight. Recently, in making slabs for the roof of a machine shop, plastic pans were tried instead of metal ones to serve as molds around which to pour the concrete. Made of Fiberglas-polyester, they are 10 inches deep and 20 inches square at the open end, with a 2-inch flange that brings the over-all size to 24x24 inches. They taper to 17½ inches square at the bottom, which is in reality the top when they are in position in the forms.

Advantages of the plastic pan are lightweight (8 pounds) that makes for easy handling, resiliency that minimizes denting and breakage, no danger of corrosion and no need of lubrication before or after use. About 1100 of them were required in making the 74x64-foot roof slab. To remove them after the concrete had set, an air jet was used. With the slab raised to give access to the underside, each pan was pried loose along one edge, and when air was directed into the opening by a nozzle the pan "popped out." In this way two men were able to remove 150 per hour.

* * *

Video to Aid Industry

Besides serving as a medium of entertainment, television gives promise of becoming an important aid to industry. Watchful cameras are already making it possible to observe the pouring of metal in steel plants from safe and comfortable vantage points. Likewise, a lens keeps an eye on smoke issuing from a stack, and the image is projected on a screen in front of an operator stationed near the combustion controls.



AIR-HAMMER STAMP

To commemorate the fiftieth anniversary of its mining and chemical industry (Staatsmijnen), The Netherlands Government has issued the special 10-cent postage stamp illustrated. It shows a coal miner using a pneumatic coal pick. To the coal-mining industry is accorded most of the credit for Holland's transformation from an agrarian to an industrial country during the past half-century.

But these and other scattered instances of video's potentialities are only the beginning, we are told. In Sydney, Australia, for instance, J.E. Telfer, of Amalgamated Wireless of Australasia, predicted at a convention of radio engineers that television's main function in the future would be that of a tool in industry and commerce. It could, he suggested, be utilized to operate coal-mining machines by remote control and thus obviate the need of miners remaining in dangerous working areas. To function in the dark, he said, the camera would use infrared light. In a similar fashion, a supervisor aboard ship could direct the movements of divers working on the bottom. Mr. Telfer prophesied that video would eventually be a watcher in many places where it is now either dangerous or inconvenient to station observers.

* * *

Miner's Lamp Afloat

In 1946, Uncle Sam had 4500 merchant ships laid up in various harbors. Since then more than half of them have been returned to active service, but there are still 2000 in reserve at eight locations on both coasts. In maintaining these inactive vessels there have been liberal applications of grease, oil, varnish and other flammable coatings. Normally the interiors of the ships are lighted by current supplied from a power barge. Many remote sections such as bilges, boiler fireboxes and the like are without lights, however, and the use of extension cords proved dangerous and inconvenient. Flashlights were tried out, but men carrying them had only one hand to work with, and the annual bill for batteries was pretty high. Someone called attention to the familiar miner's headlamp powered by a battery held in place by the wearer's belt. It was tried out and is now standard equipment for the Maritime Commission's workers.

* * *

Stealthy Miners Arrested

In Portugal tungsten ore is mined and exported illicitly, much as moonshine is surreptitiously distilled and sold in some sections of the United States. A news dispatch tells of arrests of twenty persons found gleaning the precious ore from placer deposits they do not own. Tungsten or wolfram, as it is known in Europe, is a strategic metal in great demand. Last year Portugal exported 4000 metric tons (2204.6 pounds per ton) to the United States. Aside from tungsten, it contained small amounts of molybdenum and titanium and brought an average return of $1.85 a pound.

During World War II, placer mining of the ore attained considerable importance because, with the Allies and Germans bidding against each other, the cost of wolfram metal soared to $24,000 per ton. This attracted a horde of trespassers, known as "wolframistas," who worked privately owned placers under cover of darkness, or when guards were not around, and then smuggled the product out of the country. With the price of tungsten again on the rise because of the Korean situation the clandestine operators are at it once more.

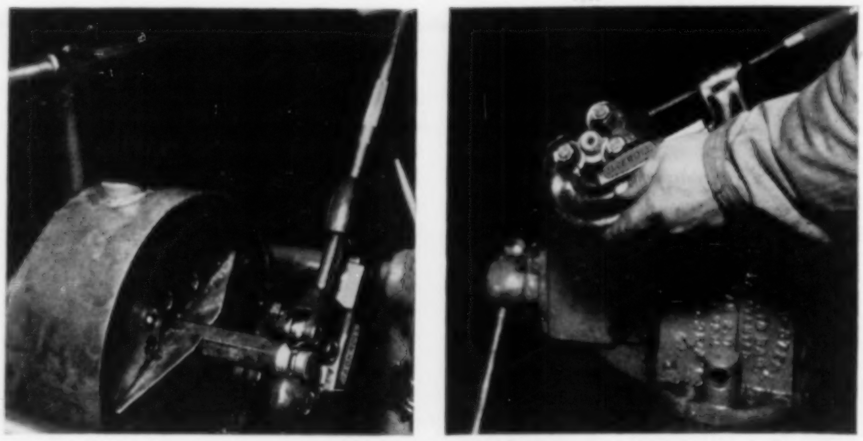
JACKROLLING

BY MEANS of a simple tool that is easy to apply, and by following accepted metallurgical practices, it is possible considerably to prolong the life of alloy-steel drill rods for detachable bits. The tool was designed by Ingersoll-Rand Company, and the procedure involves creating residual compressive stresses in the undercut section of a rod, the part between the shoulder and the threads.

Failure of drill rods is normally attributed to the effect of tension stresses developed in the undercut sections during drilling operations. But when compressive stresses are imparted to these sections those stresses must first be overcome before any tension stresses can develop; in other words, it takes more time for the latter to reach the point where they cause failure. The net result is longer rod life.

The tool that is used to produce the compressive stresses resembles a pipe cutter and is called a "Jackroll." It performs two operations. The first consists in adjusting its three rollers to fit the undercut of the annealed drill rod while the latter is held in a threading machine. Then a screw is given a ¼ turn to tighten the tool and brace it against the lathe carriage, and the machine, which is set for threading, is rotated three to six times. This causes the rod to turn in the Jackroll, which preforms the undercut and burnishes its surface in preparation for the final and vital rolling. The rod is now threaded and heat-treated.

The second rolling operation is done by hand in a manner similar to cutting pipe with a pipe cutter. For this purpose the rod is placed in a vise with the Jackroll applied the same as for preforming. But this time the tool revolves around the rod two or three times so as to reduce the diameter of the undercut about .0065 inch, thus imparting the uniform residual compressive stresses that are proving to be a life-extender for alloy-steel drill rods.



THE TWO OPERATIONS

While an annealed drill rod is rotated in a Toledo threader, left, the undercut section at the near end is rolled, the handle of the tool meanwhile being supported against the lathe carriage. The rod is then threaded and heat-treated, after which a second rolling operation is carried out by hand (right).

Mobile Refrigerator and Cold-Storage Plant

SWEDISH engineers have designed and built a rolling refrigerator plant for the preservation and transportation of perishable foodstuffs such as fish, fruits and vegetables especially in times of overabundance. It had its first tryout this year with favorable results at Finnerödja, a district which, in good seasons, produces more than two million quarts of strawberries that must be harvested in from two to three weeks.

Called the Thermo Train, the mobile unit is made up of four cars: one carrying the refrigeration machinery, two cold-storage cars and a fuel and materials car. Upon arrival at its destination it is placed on a siding and put to work freezing the crop as it comes from the pickers. The refrigerator car is equipped with two ammonia compressors—a low and a high-pressure unit—powered by a diesel engine and has a freezing capacity of 882 pounds an hour. Its walls, floor and roof are insulated with Isoflex foil, a Swedish product, and have a thickness of approximately 10 inches.

By the process, air is reduced to a temperature of minus 31°F and blown from the refrigerating plant into the cold-storage car immediately behind it at the rate of 1,765,000 cubic feet per hour. When the perishable commodity has been chilled to minus 31°, the car is uncoupled to make way for the other unit and is hauled by an ordinary train to one of the country's cold-storage warehouses where the food is held for distribution. The cars have a carrying capacity of 11.5 tons each. They are provided with cold accumulators which, together with thorough insulation, maintain them at a temperature of minus 22° for twenty hours when the temperature outside is 68°F.

The idea of the Thermo Train was advanced by Tore Lauritzon, director of the Helsingborgs Cold Storage Company, and was carried out by the latter in conjunction with the Swedish State Railways and refrigerator-plant specialists. Costing about $97,000, there is every indication that Sweden will build more of these rolling freezing units.

Compressed Air Institute Acclaimed

FOR its educational program, the purpose of which is to explain and promote applications of compressed air and air-operated equipment, the Compressed Air and Gas Institute received an award of merit from the American Trade Association Executives at its meeting held at Toronto, Ont., Canada, on September 22. The citation commended the institute for aiding the National Defense Program by disseminating information on ways to increase production by the intelligent use of air power.

The program of the institute revolves around the *Compressed Air Handbook*, 15,000 copies of which have been distributed during the past several years and which is now going into the second edition. Another phase of its work concerns coöperating with faculties of engineering colleges to acquaint underclassmen with the numerous industrial applications of compressed air. Teaching aids include pamphlets, charts and slide films, and a sound movie is being made. Copies of available material can be obtained from Compressed Air and Gas Institute whose headquarters are at 122 East Forty-second Street, New York 17, N. Y.

If De-Stat Cloth, a product of Globe Laboratories, P. O. Box 892, Sherman Oaks, Calif., does all that is claimed for it, then it is, indeed, an amazing material. The cloth is 18 inches square and is thoroughly impregnated with a chemical compound. Simply by wiping it over plastics and synthetic or natural rubber, as well as paints with a plastic or rubber base, it removes from them all static charges and prevents their reoccurrence, according to the manufacturer. It is very effective, for example, on synthetic-fiber automobile seat covers, keeping them free from dust caused by static. Materials that have been destaticized can be washed with soap or chemical detergents without losing their antistatic qualities. The cloth is nontoxic and can be used indefinitely. It is also available in a pile fabric 36 inches wide for rollers.

Industrial Notes

There is a new type of blowtorch on the market that lights automatically upon squeezing a trigger and shuts off upon release. Called the Torch-O-Matic, it is offered by the Velocity Power Tool Company as a handy tool for removing paint, for soldering and brazing and for a long list of intermittent jobs such as loosening frozen nuts and bolts, releasing shrink-fit collars and bushings, heating putty, and rebabbitting bearings. Pistol-shaped, it weighs 12 ounces and gives a flame of 2800°F the instant a flint is sparked by opening the acetylene gas-air valve. The latter can be held open for continuous operation by locking the spring-loaded trigger. Three sizes of combustion tubes are available for applications ranging from heavy soldering to precision work.

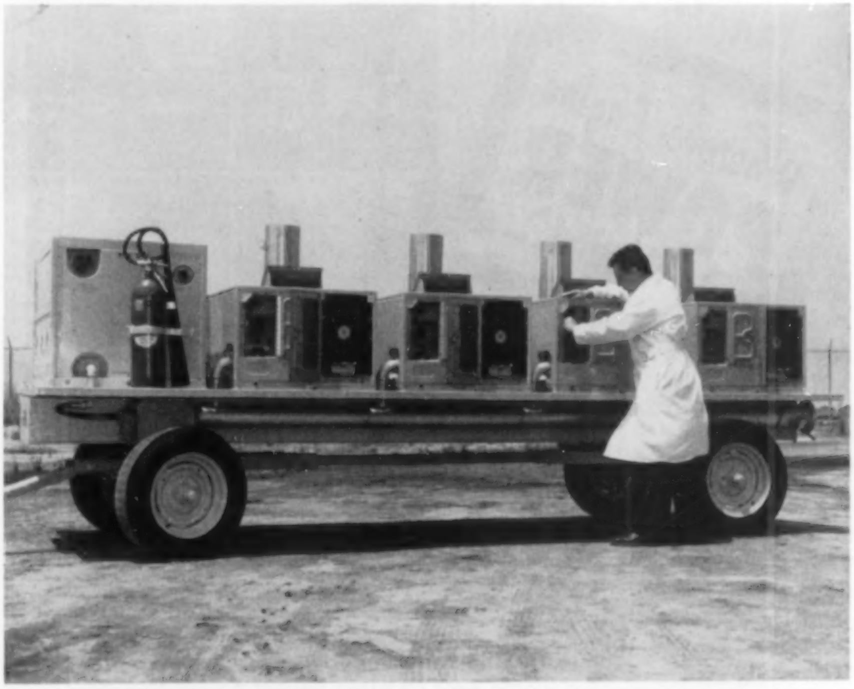
Draftsmen, architects, etc., may find Stik-tacks a handier means of fastening their paper to drawing boards than the familiar thumbtack. They are thin disks with an adhesive on both sides and are made by Thompson-Winchester Company, Inc., 1299 Boylston Street, Boston, Mass. It is claimed that they adhere also to wood, tile and glass but not to the fingers and that they peel off easily without leaving a sticky residue. They are available in ½- and ⅜-inch diameters and in packages of 82 or 328.

What is said to be the first commercial unit for the recovery of uranium from phosphate rock has been put in operation by the Blockson Chemical Company of Joliet, Ill., which has a contract to supply the strategic mineral to the U. S. Atomic Energy Commission. The latter established the fact that, small though the uranium content is, it could be extracted profitably from the raw material during its manufacture into sodium-phosphate chemicals and concentrated fertilizers. Several other processors of phosphate rock are incorporating uranium-recovery units in plants now under construction in Florida and Texas, where there are extensive phosphate deposits.

As a substitute for conventional buffing wheels, Minnesota Mining & Manufacturing Company is offering a belt coated with granulated cork instead of mineral grains. Designated as the 3M Wetordry brand, the belt is sized with resin combined with a polishing agent and has a waterproof cloth backing to which the bits of cork are bonded. It is intended primarily for edge-polishing glass, but will give a high surface finish also to ceramics, metal and plastic. All standard sizes for abrasive-belt grinding and polishing equipment are available.

With the new Caufield Separator it is no trick at all, says the Clark-Hopkins Equipment Corporation, to pick up one sheet of steel after another from a pile for transfer to a press or machine. Just how it works is not explained, but the top sheet is always raised about 2 inches above the stack, giving the operator plenty of room to take hold. As a sheet is removed, the one beneath it is lifted, and so on. With the device there is less chance of cut and bruised fingers and no danger, it is claimed, of feeding two pieces into a press and damaging dies. The separator is used singly or in pairs, and four sizes are available.

More than 29 million tons of slag from the nation's iron blast furnaces was sold last year for $36,307,693. Air-cooled slag is crushed in 68 plants and marketed for such uses as railroad and highway ballast, concrete and bituminous aggregate and for miscellaneous construction purposes. Seventy-nine percent of the 1951 output was in this form. Of the remainder, more than two million tons was expanded for use in concrete blocks and for aggregate in lightweight concrete. Gran-

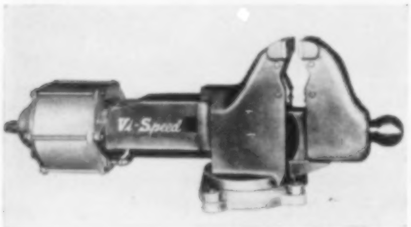


AIR STARTER FOR JET PLANES

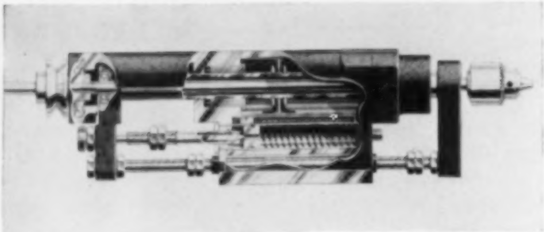
Shown here are four truck-mounted gas-turbine compressors designed for starting the Pratt & Whitney J-47 engines that power the Boeing B-52 jet bomber. The compressors act in unison and have a total output of 160 air horsepower. Each unit has its own starting and ignition system and operates at 36,000 rpm on fuel obtained from the tank that is mounted at the left. In addition to starting jet planes, the assembly furnishes power for the B-52's electrical and hydraulic auxiliaries when the main engines are not running. The pneumatic power set is produced by AiResearch Manufacturing Company.

ulated slag, amounting to 2,249,281 tons, went into hydraulic cement, road fill and concrete blocks. The leading slag processing states are Ohio, Pennsylvania, Alabama and Illinois.

Volume production has been started by Van Products Company on two pneumatic vises after several years of testing under actual service conditions. Of the bench type, they have a power ratio of 100 to 1 and are operated by an air cylinder of the single-acting type with a fully enclosed spring return, an 8-inch bore and two pistons each of 50 square inches separated by a removable cylinder head. The piston or jaw stroke is $1\frac{3}{8}$ inches, maximum, and is regulated by a safety stop screw. Air-pressure requirements range from 15 to 150 psi. There are two models—610 DP and 1000 DP—with jaws 6 inches wide and openings of 10 and 11 inches, respectively. The former is available with smooth jaw faces and a stationary or swivel base, while the latter, which is illustrated, has a swivel base and also incorporates heavy jaws for pipes of all sizes up to 6 inches inclusive. Both vises are controlled by means of a foot valve.



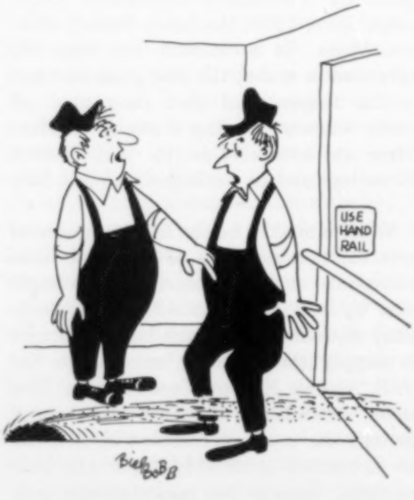
By use of a new cable announced by Anaconda Wire & Cable Company, there is little danger of arcing and shock when a break occurs in a cable delivering current to portable mining machinery. According to the company, power is cut off by a ground trip relay that is energized the instant the insulation of the positive conductor is damaged. The cable meets all requirements of the Federal Mine Safety Code, Schedule 2E of the U.S. Bureau of Mines, as well as Pennsylvania Act No. 206.



An air-powered drilling unit that it has taken six years to develop is now being manufactured by Alkon Products Corporation. Known as the Gurmendi drill, it has been designed for high-speed production, as well as ease of operation and maintenance. The unit embodies a Hydraulic Monitor (a composite air and hydraulic cylinder) that is said to insure quick approach to the work, without danger of break-through, and rapid return. Stroke is a full 2 inches with $1\frac{1}{4}$-inch feed. Both strokes are adjustable by means of stops. Of honed steel, the monitor is an integral part of the unit and controls the rate of feed of the spindle at any point in its travel. The latter is equipped with a Jacobs chuck with a capacity of $\frac{1}{4}$ inch. The base is machined in alignment with the spindle to facilitate setup on brackets and fixtures. Rate of speed, up to 12,000 rpm, is adjusted by changing the size of a standard spline pulley, which is mounted rigidly in the housing with precision ball bearings to eliminate shaft loads. Because of the compact design, two or more drill units can be mounted as close as 2 inches between centers and many can be powered by one motor of any standard make of sufficient capacity for the job.

Truck drivers can keep warm on cold nights and start their engines in the morning without difficulty by means of a heater developed by a Minnesota mechanic, according to the American Petroleum Institute. The unit is little larger than an oil filter and burns bottled gas such as is used in rural areas for cooking and heating. Mounted on the side of the engine, it is connected to the block by a rubber hose and is said to keep the equipment in working order no matter how low the temperature drops.

Clothing and personal safety equipment such as respirators, face shields, ear defenders, etc., can be cleaned and made sanitary, it is reported, by use of a prod-



"Better go downstairs and check the setting of that saw."

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Single cyl. 3 to 9 H.P.

2-cylinder 7 to 13 H.P.

V-type 4-cyl. 15 to 30 H.P.

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Because Wisconsin Air-Cooled Engines are supplied in a complete power range, from 3 to 30 H.P., in 4-cycle single cylinder, 2- and 4-cylinder types, there is an ideal size to fit all types of machines and power applications within this range, without wasted power and with maximum power service benefits. Heavy-duty construction, combined with extremely compact design and light weight are added advantages—and dependable AIR-COOLING permits trouble-free service under all climatic conditions.

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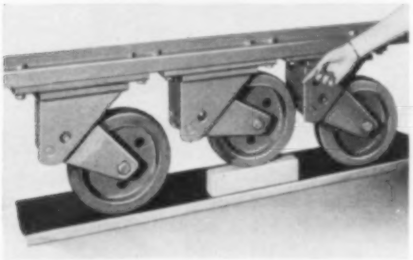
uct offered by Mine Safety Appliances Company. The Cleaner-Sanitizer, as it is known, is in the form of a powder of which an ounce is added to a gallon of lukewarm water. No soap film remains on wearing apparel and equipment so cleaned, rinsed and air-dried, says the manufacturer, and the bacterial count is reduced to levels considered safe by public-health standards.

Numerous advantages over conventional wheels are claimed by the All Steel Welded Truck Company for its new knee-action, shock-absorbing caster now being made in varying sizes and in rated standard capacities from 50 pounds or less, if required, to 1500 pounds or more per caster. Deflection in the 6- and 8-inch wheels is in excess of 1½ inches and in the 10- and 12-inch sizes 2 inches. A unit with a 6-ton rating and a deflection of more than 3 inches is now being designed. Called the Clark Duoflex, the caster has but one moving part with lifetime lubrication, springs are fully enclosed, and construction is of the fabricated "boxed" type. Among the claims made for the new product by the manufacturer are: savings in caster maintenance, elimination of fishtailing because wheels are always in contact with the floor, and easy handling of trucks—they can be pushed from two to four times faster than those with conventional wheels.

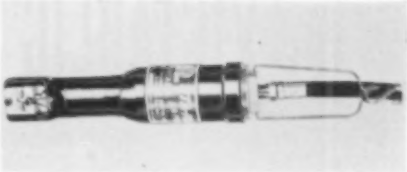


Stubby cylinders of a new, extremely hard synthetic material are said to be more efficient than flint pebbles and porcelain balls for grinding hard substances in ball mills.

Distilled water can be obtained instantly, it is claimed, by means of a portable deionizer consisting of a polyethylene bottle, which is filled with tap water, and of a synthetic resin filter through which the water is squirted. A 2-ounce filter provides 20 gallons of pure water before it is spent, which is indicated by a change in color.

Safety devices and controls of many kinds have been invented to protect the hands of operators of punch presses, power shears, and the like, but none is perhaps as ingenious as the safeguard recently announced by Modern Air Corporation. Called Hazatrol, it involves the use of a Geiger counter and wearing of a radium-bearing wristband. Should a worker's hands stray into the danger zone, the Geiger counter instantly picks up the radium radiations and operates an antitrip device that continues to function and keeps the machine idle until his hands are out of harm's way. The radiations cannot be cut off by materials moving in and out, as may be the case where an electric eye is depended upon to ward off danger.

For the installation of wire terminals on a production-line basis, The Thomas & Betts Company, Inc., is offering a lightweight air-hydraulic tool that can be taken to any job where an air hose can follow, or mounted on a workbench and actuated by a foot valve instead of a trigger. It is designed to operate on air-line pressures from 75 to 150 psi, and exerts a force of two tons on the dies, which always close all the way because there is no mechanical linkage to cause wear, says the manufacturer. Interchangeable dies permit the installation of bare or self-insulated Sta-Kon



"AS GOOD AS NEW"
- after 19 YEARS service!

"My company, in 1932 installed a Sauerman Slackline Cableway purchased from an English agent of Sauerman Bros., Inc. This plant, normally maintained, is as good today as when we bought it. Between 1932 and the end of 1951 it excavated and yielded to the hopper 2,222,783 tons and we expect it to continue producing at this rate for possibly ten more years before it is retired. I give the equipment a high rating for performance. Up to 1952, the capital cost divided by 19 years' output amounts to less than ⅓ cent for each ton handled. Maintenance expense of the machine over this period also has been moderate."

Mr. C. Maw, Director
Stanley Ferry
Gravel Co., Ltd.

SAUERMAN
Slackline Cableway

The excavation and movement of gravel to the screens at the plant of Stanley Ferry Gravel Co., Ltd., Leeds, England, has been a "one man, one machine" job since 1932, handled entirely by the Sauerman Slackline Cableway shown in the picture above.

During this period the Sauerman machine has moved over two million tons of gravel at a capital cost of less than one-third cent a ton, and with nominal repairs continues to give as good service as when new. Its operating cost matches its capital cost for economy.

The deposit is tightly packed and contains many submerged swamp trees. Water table is 9 ft. below ground level. Gravel extends to a depth of 30 ft. The material is very abrasive. Altogether, it is a tough test of a machine's power, range and durability.

The Sauerman machine operates on a 750-ft. span from a steel mast 90 ft. high, and soon will have taken out all the aggregate within its reach. The mast will then be moved to a new location approximately 900 ft. from where it now stands. This will be the third move. The first pit excavated by the cableway is behind the plant in the background.

The 150-hp. machine digs and conveys 100 tons per hour, delivering to a cantilevered hopper on the mast. A ropeway conveys the material from the hopper to the screening plant located on a highway 1,000 ft. away. The cableway could produce considerably more than 100 t.p.h. but is limited by the capacity of the ropeway.

This 19-year old installation is just one of many Sauerman installations scattered through every state in the United States and in many foreign countries that have proved wonderful long term investments for their owners, while maintaining large daily output at small expense.

For complete details of the different sizes and illustrations of the varied uses of Sauerman Slackline Cableways, write for new, free 24-page Catalog C.

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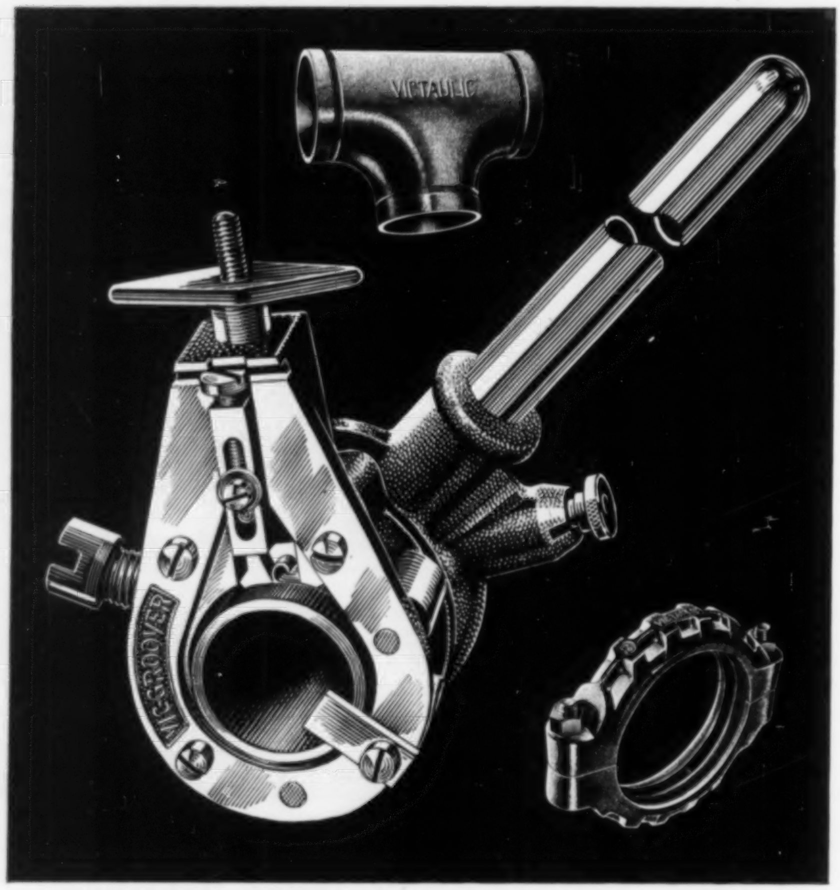

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Time and money-saving "Vic-Groover" Tools are only part of the *complete* Victaulic Method. Portable and easy-to-use "Vic-Groovers" are available in 9 sizes up thru 6", prepare pipe ends on the spot for quick easy hook-ups with Victaulic Couplings and Fittings, and they're automatic as to groove positioning and depth!

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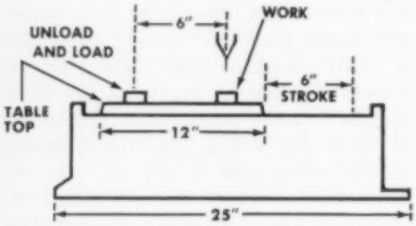
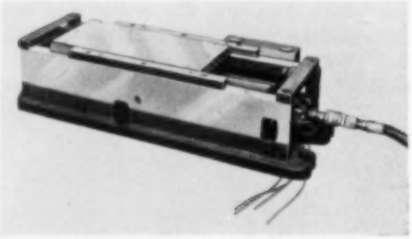
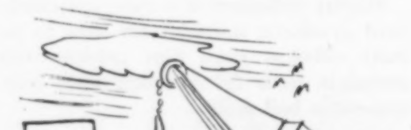
terminals on AN or AWG wires, No. 22 through 10. Dies are spring-loaded to hold terminals while the wire is inserted, but can be made self-opening.

To its line of Controlled Air-Power devices, The Bellows Company has added a 2-station work feeder that is designed to cut idle machine-tool time in half. It consists of a movable table top, 5¼ inches wide and 12 inches long, that is guided between hardened ways. Power is supplied by a special Bellows air motor with a built-in Electroaire valve that can be controlled by push button or foot switch or interlocked with other machines. All electrical connections and switches are housed in a box on the side of the base casting. Known as the Transfeed Work Feeder, it has a 6-inch positioning stroke which enables the operator to load and unload at one end while machining is going on at the other. The unit is provided with adjustable stops for accurate positioning, and holding fixtures may be attached to the table top or mounted on oversize tops.







"Jenkins, we'll hafta let ya go. We just found out ya don't have a college education."

QUOTES

—FROM HERE AND THERE

Shaft-sinking Recollections

In sinking a mine shaft, "the next step, after firing the round, is to lower the sinker pump and make the bottom as dry as possible. Then the back-breaking job of mucking out begins. In the old days this was done by hand but . . . a mucking machine is being perfected, and already, with the first models, the toughest job in mining has been made easier.

"During the sinking of the Mollie Gibson shaft at Aspen, Colo., I was assistant to the civil engineer making a survey. Dressed in rubber clothes . . . I had established a survey station in the last set of timbers in the inclined shaft. The noise was deafening. Two No. 9 Cameron pumps, actuated by steam, were hanging in the shaft and running at full capacity, the exhaust being bypassed into the water column above the pumps. Water was . . . running down the shaft in torrents; men were stripped to 'G' strings . . . drilling the round . . . .

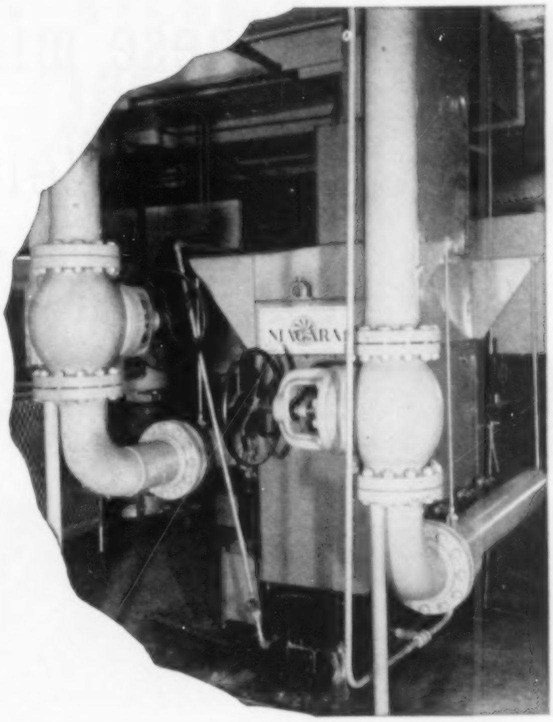
"I saw the men load the holes in that never-ending stream of water; I saw the two Cameron pumps pulled up out of danger from flying rocks; I saw the miners cut the fuses to proper lengths to give the rotation of firing they desired, gather the fuses in a bunch and light them with a red-hot iron . . . . After the round was shot and the powder fumes . . . sucked out . . . the water was knee-deep on top of the muck. The Cameron pumps were lowered and after considerable pumping . . . the men could descend the chain ladder and start mucking . . . .

"When the rich . . . deposits of Leadville . . . and Aspen were discovered, the mine operators were faced with a pumping problem . . . . Immense and powerful simplex, duplex and triplex pumps were installed underground, driven by steam with their exhausts carried into the sump. The heat was terrific. The pumps ran with the utmost precision and caused very little mechanical trouble . . . .

"The adjunct to the powerful station pumps was the old reliable Cameron sinker. As far back as the writer can remember (about 1890), these pumps have been the favorite for lifting water from the bottom of the shaft to the station pumps. The most popular models were the Nos. 5, 7 and 9. When first introduced they were run by steam, but in more recent years by compressed air; they are sturdy and strong and stand the shock of blasting.

Frederick E. Browne, mining engineer of Pasadena, Calif., in a paper on progress in metal-mining plants and development read at the American Mining Congress meeting held September, 1952, in Denver, Colo.

How to get drier or cooler air or gases . . .



NIAGARA AERO AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.

If you use compressed air to operate tools or pneumatic equipment you save much in water and oil damage to tools and equipment, and in water damage to materials by using the Niagara Aero After Cooler.

Write for a bulletin, or ask nearest Niagara Field Engineer if you have a problem involving the industrial use of air.

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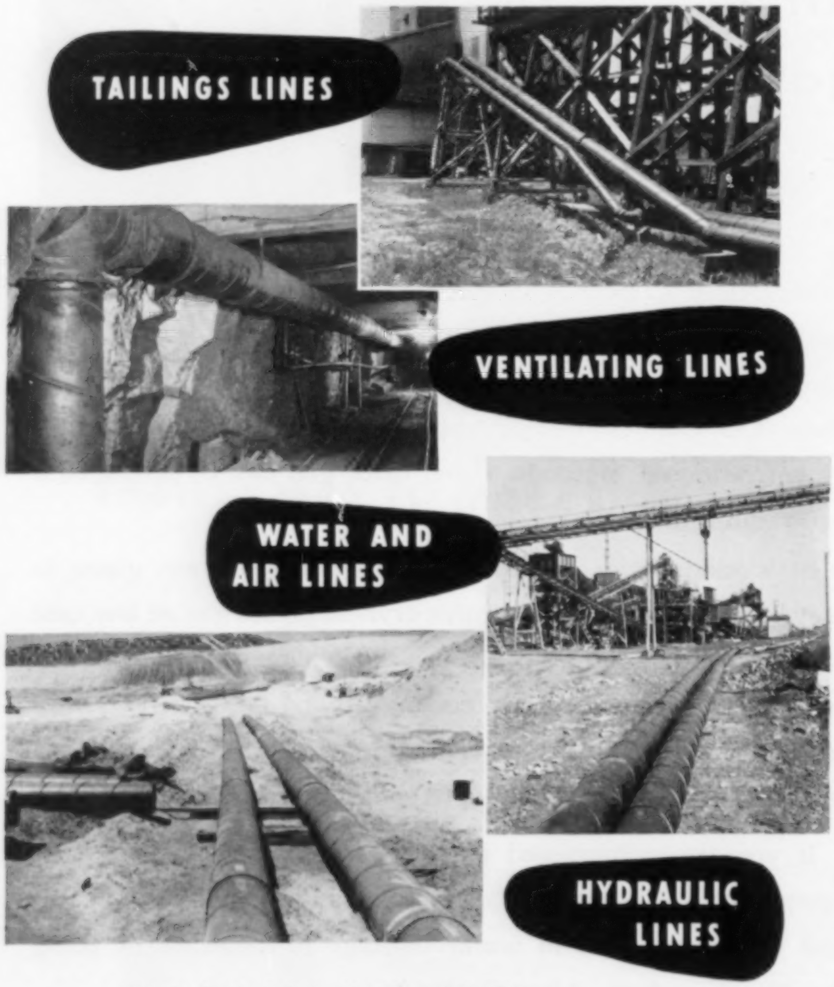
Experienced Field Engineers in Principal Cities of U. S. and Canada

On any of these mining jobs NAYLOR Light-Weight Pipe gives you PERFORMANCE THAT SPEAKS FOR ITSELF



Write for Naylor Bulletins No. 507 and No. 513

NAYLOR PIPE

Naylor Pipe Company
1245 E. 92nd St., Chicago 19, Ill.
New York Office:
350 Madison Ave., New York 17, N.Y.

Wooden Roof Bolts

"Operators of a Hopkins County coal mine saved more than $27,000 by using wooden roof bolts instead of the conventional type. The hickory wood bolts made in the mine's shops cost less than 20 cents each, compared to $1 each for steel bolts."

From Easton (Pa.) Express, September 12, 1952

Spray Methods Compared

"A portable hot plastic spray unit designed by a master mechanic at the Long Beach Naval Shipyard greatly facilitates application of hot plastic ship-bottom paint. The unit consists of a 250-gallon steam-jacketed mixing kettle, air-operated propeller-type agitator, and heavy-duty double-action air-operated pump. In actual test with the unit, four men painted 40 per cent of a destroyer hull in less time it took nine men, using the older spray method, to cover the same area of another hull."

From Journal of The Franklin Institute, September, 1952

New Use for Formaldehyde

"Formaldehyde, a chemical much used in the manufacture of plastics, dyes and drugs, may help petroleum refiners remove impurities in cracked gasoline. At present, sulfuric acid is used to remove these impurities, which can cause gum in engines. But with the current shortage of sulfur, some other method was sought. Ingenious chemists in an oil company's research laboratories came up with the formaldehyde technique, which may prove to be even more satisfactory than sulfuric acid."

From Petroleum Newsnotes, March-April, 1952

Gas from Coal in Place

"An improved method of turning coal into gas without removing the coal from the ground has been invented by Louis L. Newman, Washington, D.C., and William C. Schroeder, Clinton, Md.

"Drawbacks in previous methods . . . were that the coal was not always entirely consumed and that the gases themselves sometimes caught fire before they could be brought above ground. The inventors claim they get around these two difficulties by drilling holes into the coal seam, the holes being in rows. The air, or other oxygen-containing gas needed to support the burning of the coal, is fed into the coal seam through one row of holes, while the resulting gases are drawn off in the second row. Other smaller holes are drilled in between the rows. When the gases catch fire, nonburning sealing materials can be pumped into these intermediate holes to seal the gases off from the oxygen and the fire."

Western Canada Coal Review, September, 1952

Industrial Literature

Uniflow Manufacturing Company, Erie, Pa., makers of domestic water-conditioning equipment for twenty years, has entered the industrial field. A folder describing its new water softeners ranging in capacity from 150,000 to 950,000 grain gallons is available.

Literature may be obtained from F.T. Griswold Manufacturing Company, 305 West Lancaster Avenue, Wayne, Pa., on its Huet optical level for measuring deviations from the true horizontal of one-hundred thousandth of an inch per inch of length. For full information request Catalogue 30.

Thermobloc Division of Prat-Daniel Corporation, South Norwalk, Conn., has announced a new general catalogue (GNC-10-52) on its industrial heaters. In addition to installation views and line drawings it features a cutaway illustration in color of a direct-fired unit and gives specifications and dimensions of all models available.

Everything for Safety, a 144-page catalogue, lists safety items from goggles to boots and machine guards manufactured by The Boyer-Campbell Company, 6540 St. Antoine Street, Detroit 2, Mich. The publication is dedicated to the "fifth freedom" —freedom from accidents. Copies will be mailed free of charge upon written request.

Because Moisture Isn't Pink is the title of a 32-page bulletin which deals with dehumidification and its solution by the use of Lectrodryers. It contains 70 installation views and diagrams and goes into many production, handling and storage problems due to moisture. Bulletin No. 222 can be obtained without charge from Pittsburgh Lectrodryer Corporation, P. O. Box 1766, Pittsburgh 30, Pa.

The Science of Economical Shelf Storage is the title of a catalogue obtainable from The Frick-Gallagher Manufacturing Company, Wellston, Ohio, and dealing with its space-saving Rotabin System for storing parts, tools and materials. Profusely illustrated, it covers the general line of rotating shelving, as well as special types and accessories used in combination with them.

Bulletin No. 604, another Ess Instrument Company publication in its photoelectric-eye series, covers Turbidity Recorder-6 for measuring the amount of light cut off by undissolved substances suspended in fluids. It contains pertinent information on the operating principle, gives range of applications and includes sketches of various chambers, indicators and recorders. Address inquiries for copies to Bergenfield, N.J.

Locknuts, published by the Locknut Section of Industrial Fasteners Institute, 3648 Euclid Avenue, Cleveland 15, Ohio, describes and illustrates representative types of locknuts, their uses and principles of operation. The purpose of the 23-page book is to help purchasers select the type best suited for each application. As a further aid it gives the names and addresses of the manufacturers of the different kinds listed.

Sharon Steel Corporation, Sharon, Pa., has announced a 11-page bulletin descriptive of its Type 430 stainless steel. It has been prepared primarily as a guide to manufacturers who may be considering the metal for use as an alternate for materials now in short supply. In addition to tables giving its chemical, mechanical and physical properties, the booklet includes basic fabrication information and lists typical applications.

MAXIM SILENCERS
ON GUARD!
FOR GOOD PUBLIC RELATIONS

BELOIT
POWER AND WATER PLANT
HAS FAIRBANKS-MORSE DUAL FUEL
ENGINES

The new power plant at Beloit, Kansas, is a quiet and good neighbor, 24 hours a day, because of the Maxim Silencers shown above. Illustrated are four exhaust silencers, and behind each of the two-unit oil bath filters a Maxim intake silencer quiets the scavenging air inlet. The larger exhaust silencers serve the two new engines, and the smaller silencers the two older engines. In any municipal plant, good silencing means good public relations. If you have a silencing problem, let Maxim's long experience in this field solve it for you.

The two new 2000 h.p. Fairbanks-Morse dual fuel engines used for power generation.

Consult MAXIM

DR. SHUSH

THE MAXIM SILENCER COMPANY
61 Homestead Ave., Hartford 1, Conn. Dept. W.L.

Gentlemen:
Please send me your bulletins on Exhaust and Intake Silencers.

Name ____________________

Company ____________________

Address ____________________

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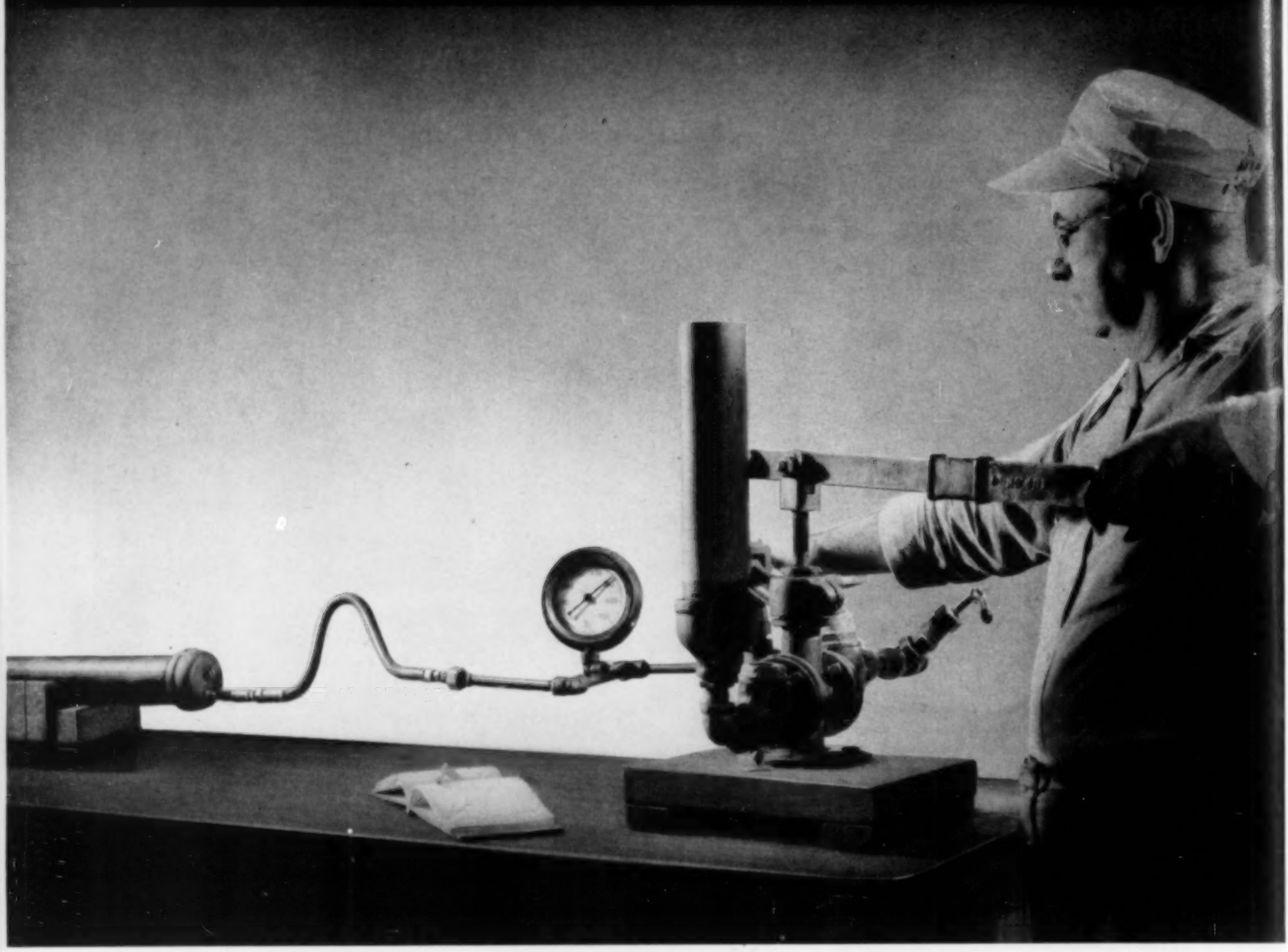
21MX52

PROGRESS IN EXPLOSIVES . . .



FOR WORKING UNDER PRESSURE

Hercules' research has developed explosives that shoot successfully even under the severe water pressures encountered today in seismograph prospecting.

In the laboratory test shown here, a cartridge of Hercules Vibrogel® 3 is sealed in the steel "bomb" at the extreme left. It then undergoes prolonged exposure to pressures greater than those ordinarily found in actual field use. Because Vibrogel 3 embodies a new conception of explosives research, it detonates despite these extreme conditions.

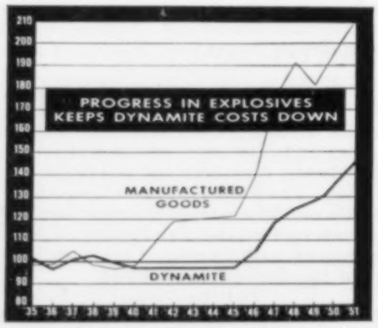


Chart shows relative stability of dynamite prices since 1935, as compared with prices of other manufactured goods. 1935-39 values=100.

HERCULES POWDER COMPANY

INCORPORATED

Explosives Department, 932 King St., Wilmington 99, Del.

XR52-7

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER

Now–two types of hose handle 95% of all air hose needs

Save days of waiting for special hose—save money, too

B. F. Goodrich makes an air hose for every purpose, but on the average two types of hose—Highflex and Type 50—are best for 95 to 99 out of every hundred air hose needs.

For general service—Type 50 is the most versatile hose made today. It's used for tie tamping, light and heavy portable compressors, air hoists, ore mining, quarry service and drills (left, above).

For hard-to-get-at-jobs where light weight and flexibility are so important, your best buy is Highflex. Weighing only half as much as ordinary air hose, Highflex is many times more flexible, making it easy to use in tight corners, easy to pull down a production line. Yet it has higher burst strength than heavy old-type hose of the same size. Especially designed for use with small shop tools (as shown at right, above), it's equally serviceable as welding hose, water hose, or even as a low pressure hydraulic hose.

Oil won't rot them—Both Type 50 and Highflex have tubes that won't break into loose, gummy particles to clog up tools. Their covers are oil-resisting, too. Can be dragged through oil or grease without damage.

Rough treatment won't tear them—Both types of hose have abrasion-resistant covers. Scraping over rock, rough floors, cinders or roads won't tear them. Won't check or crack from constant sunlight.

Saves waiting—B. F. Goodrich distributors have both Type 50 and Highflex for immediate delivery. Now there's no need to hold up production while waiting for special kinds of hose. For quick delivery the next time you need air hose, call your local BFG distributor or write *The B. F. Goodrich Company, Industrial & General Products Division, Akron, Ohio.*

Air Hose
BY
B.F. Goodrich

WHAT ALLOY STEEL CASTINGS* MEAN IN UNDERGROUND LOADING MACHINES

The structure of steel castings is uniform for greater strength, shock and stress resistance.

In steel castings the metal is distributed where it will do the most good—for maximum strength and minimum weight.

High rigidity, minimum deflection, accurate alignment, close tolerance and better fit are all inherent characteristics of steel castings.

Steel castings have high fatigue resistance, maximum endurance and longer life—ideal qualities for critically stressed parts.

Model 21 Eimco
Lower Deck

Model 21 Eimco

EIMCO

A407

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 10, UTAH, U. S. A.

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EL PASO, TEXAS, MILLS BUILDING • BERKELEY, CALIF., 637 CEDAR STREET
KELLOGG, IDAHO, 307 DIVISION ST. • LONDON W. 1, ENGLAND, 190 PICCADILLY

IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
IN ENGLAND: EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
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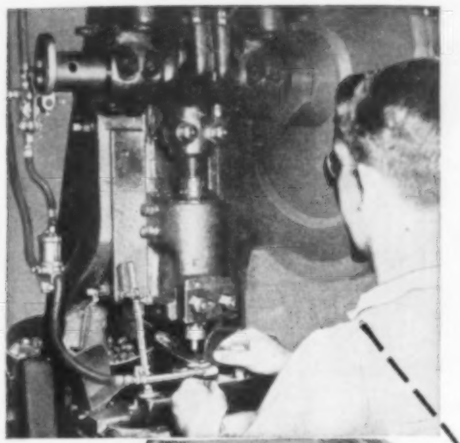
*All EIMCO Loaders are built with alloy steel parts throughout. This is an exclusive EIMCO feature.



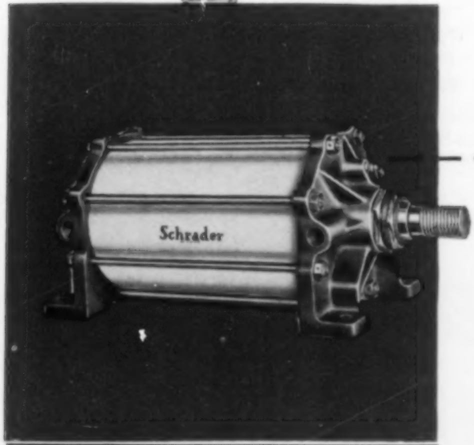
Some equipment just naturally boosts production

. . . Schrader Air Controls for instance. *You can't help* getting smoother, faster operations with air power on your side.

The tireless muscles of compressed air lighten labor all along the production line.

● *For ejection of work,* Schrader Air Ejection Sets automatically eject finished parts . . . eliminate tedious hand removal or bulky mechanical devices.

● *On power presses,* press brakes, and any machine using either a friction or mechanical clutch, Schrader Machine Controls promote building a high-speed work rhythm that pays big production dividends with safety.



● *All over the shop,* Schrader Air Cylinders are faithfully on the job, delivering more powerful straight-line forces than any other commonly used power units of equivalent size or weight.

These are only three of the many hundreds of new and improved Schrader Air Control Products that build production and safety in your plant. It's easy to plan their use in many places in your shop. Write, outlining your installation, your idea—or fill out the coupon below.

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REG. U. S. PAT. OFF.

products control the air

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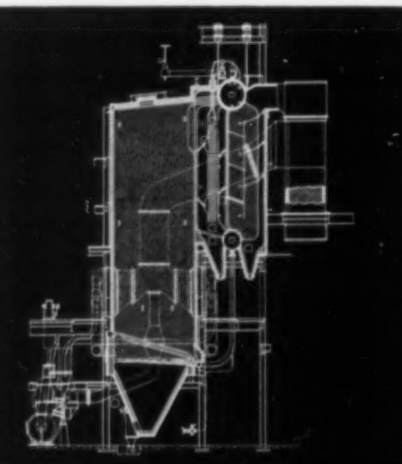
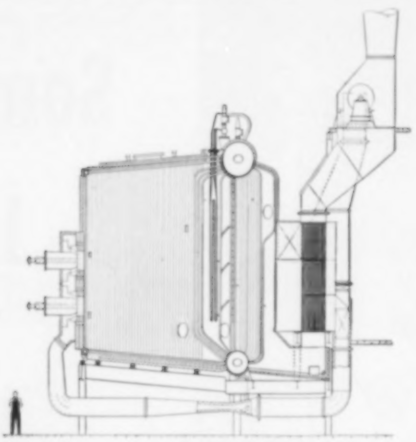
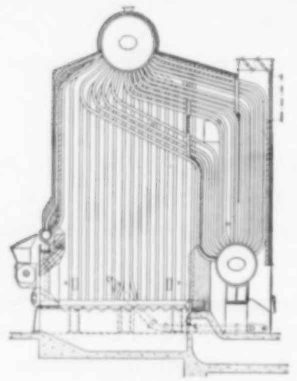


VU-50 Boiler — This unit, one of five duplicates, serves a large tube mill. Designed to burn pulverized coal and blast furnace gas. Capacity — 175,000 lb steam per hr; oper. press. — 850 psi; steam temp. — 750 F.



VU-50 Boiler — This unit, one of five duplicates, is at a Midwestern steel plant. Designed to burn blast furnace gas and coke oven gas. Capacity — 100,000 lb steam per hr; oper. press. — 425 psi; steam temp. 700 F.



VU-10 Boiler — This unit, one of two duplicates, is in service in an Eastern steel mill. It is fired with a C-E Spreader Stoker. Capacity — 22,500 lb steam per hr; oper. press. — 100 psi; no superheat.

Leading Metal Producers using VU units in one or more plants

Aluminum Company of Canada, Ltd.
Anaconda Wire & Cable Co.
Bethlehem Steel Co.
Bridgeport Brass Co.
Chase Brass & Copper Co., Inc.
Cia. Siderurgica Nacional
Great Lakes Steel Corp.
Jones & Laughlin Steel Corp.
National Tube Co.
Phelps Dodge Corp.
Pittsburgh Steel Co.
Republic Steel Corp.
Revere Copper and Brass Inc.
Sloss-Sheffield Steel & Iron Co.

Industry Leaders select VU

One significant fact about the C-E Vertical-Unit Boiler is its wide acceptance by leading companies in practically every industry. This is so important to *all* companies because buying decisions of the larger manufacturers are often a practical guide for everyone right down the line.

Primary metal producers are an outstanding example. The reliability of their steam generating equipment is of utmost importance, since steam failure may cause extensive damage to costly equipment. It is especially significant then that many of the world's largest metal producers, each guided by its own investigations and conclusions, reached a common decision as to the merits of Vertical-Unit Boilers.

These companies have *proved* their satisfaction with VU Units by buying them again and again. One company purchased three in 1940 . . . three more in 1946 . . . five in 1949 . . . and two in 1951 — *thirteen units in eleven years.* In fact, the fourteen companies listed here have bought a total of 69 Vertical-Unit Boilers.

You can profit from the example of the primary metal industry — or from any industry where steam is exceptionally important. You will find — as so many others have found — that the C-E Vertical-Unit Boiler means lower steam costs through advanced design . . . sound construction . . . proved reliability. If you need steam — from 10,000 to 350,000 pounds per hour — take a tip from the leaders — investigate VU.

C·E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

B-625B

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

$ave Power

and

REFRIGERATION COST

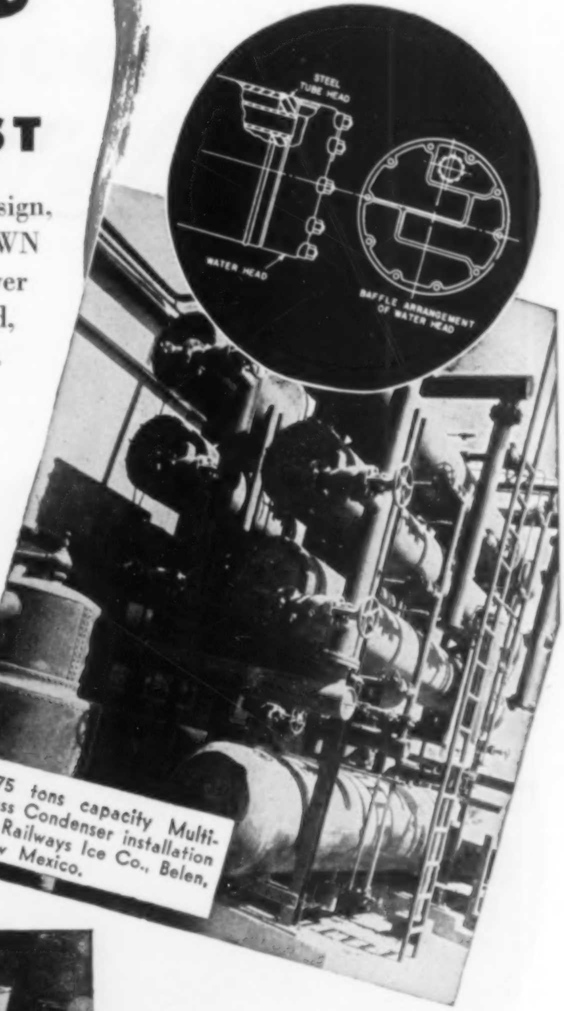
Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers

(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

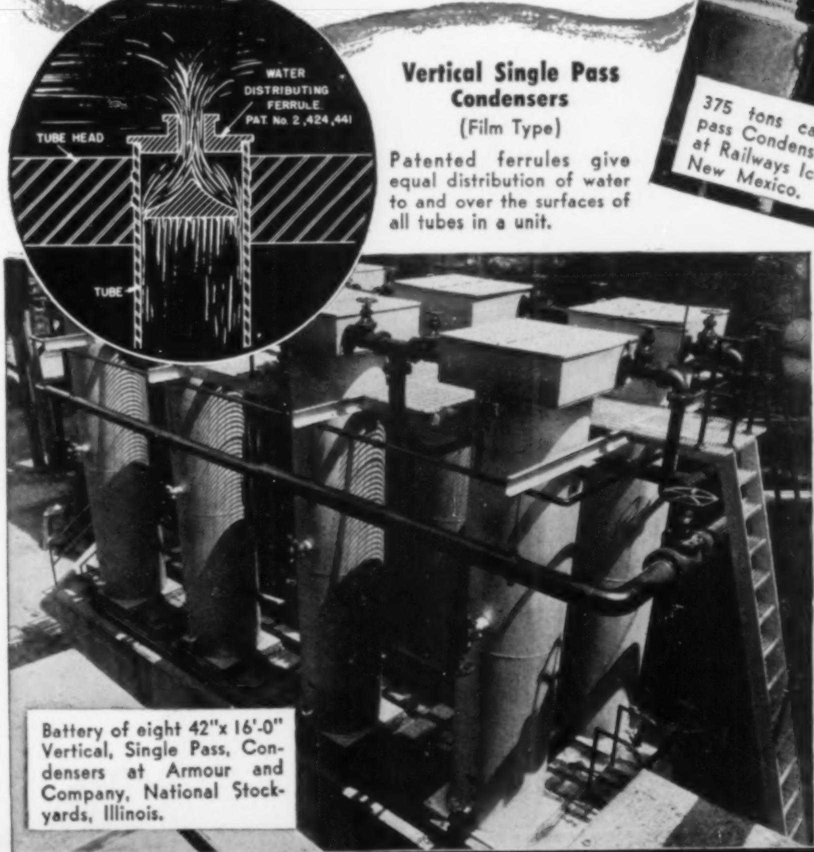


375 tons capacity Multi-pass Condenser installation at Railways Ice Co., Belen, New Mexico.

Vertical Single Pass Condensers

(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Vogt REFRIGERATION CONDENSERS

PROTECTED BY Bonderite FOR CORROSION RESISTANCE
WESTINGHOUSE
Life-Linestarter
RESET
WESTINGHOUSE
Life-Line
DO NOT LUBRICATE

WHAT *Life-Lines* REALLY DELIVER IS MORE SERVICE...LESS SERVICING

See how the maintenance has been engineered out with modern *Life-Lines*

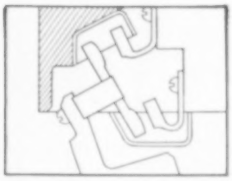
Forget your previous ideas of motor and control maintenance. The advanced design of Life-Line motors and Life-Linestarters sets new lows in maintenance. Excessive maintenance has been engineered out—in advance.

Take the Life-Linestarter for example: There are fewer moving parts. Operation is simple. No complex linkage in contact closing arrangement. No sliding surfaces. No hinge pins. Contacts, too, are protected by the exclusive deionizing principle of arc extinction—the most efficient method devised. Contact burning is minimized—contact maintenance engineered out!

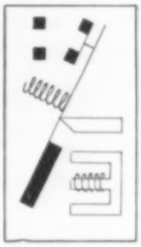
And the Life-Line motor has set new standards for motor manufacturers. Pre-lubricated bearings do away with lubrication maintenance. Heavy structural steel gives new strength . . . provides more torque per pound. New stator slots and insulating material add years of maintenance-free service.

Summed up—what is really engineered and built into Life-Lines is simply—more service on the job—less servicing, and down time. Ask your Westinghouse representative to show you proof that Life-Line motors and Life-Linestarters are the equipment built to match the high productivity requirements of today's industry. A call to your local office will bring you fast service, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

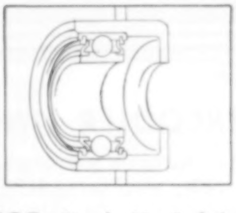
J-21696



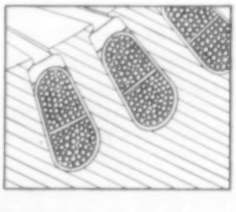
STARTER *Exclusive "De-ion®" Arc Quencher* confines, divides, extinguishes hot arcs fast!



Never Jams. No sliding surfaces to wear—no sticking—no jamming—nothing to wear or replace.



MOTOR *Needs No Lubrication.* Pre-lubricated factory-sealed bearings eliminate troubles due to over or under lubrication, dust and dirt.



Cuts Winding Burnouts. Pear-shaped slot design eliminates pockets. No corner voids remain to collect dirt, moisture.

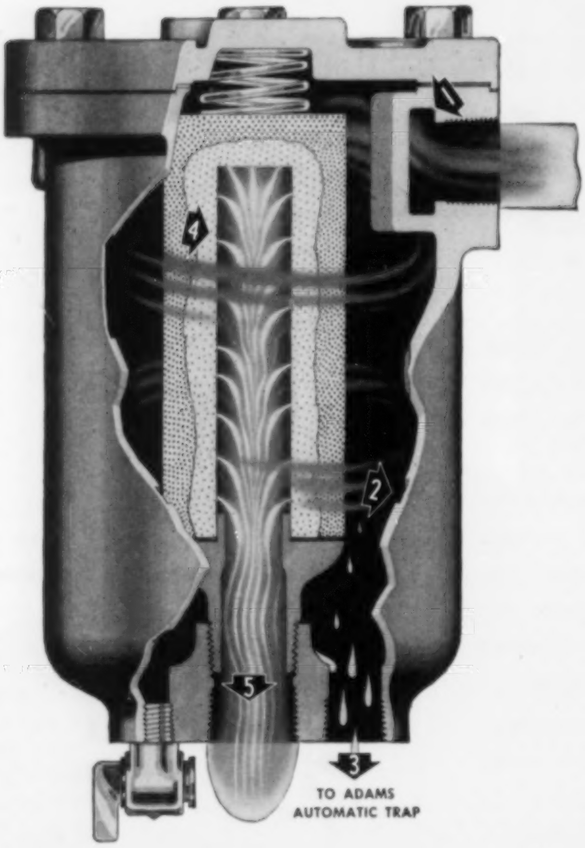
YOU CAN BE **SURE**...IF IT'S

Westinghouse

Life-Line

MOTORS and CONTROLS

ADAMS *has both* *


4
2
5
3
TO ADAMS AUTOMATIC TRAP

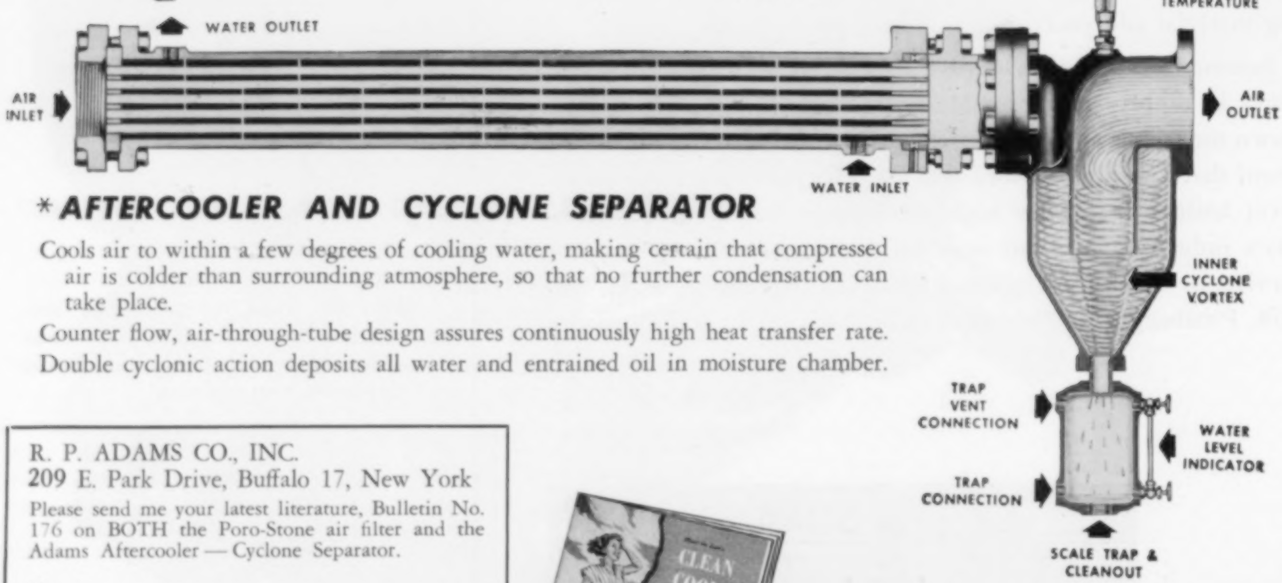
— BOTH ANSWERS TO THE PROBLEM OF KEEPING WATER, WATER VAPOR, OIL AND DIRT OUT OF COMPRESSED AIR LINES

There's no *one* answer to this problem! The most expensive aftercooler you can buy will not remove scale that is picked up in the distribution lines. The most expensive air filter you can buy cannot guarantee removal of water vapor until it has been condensed by cooling. That's why Adams makes both.

* PORO-STONE *AIR FILTER*

1. Centrifugal separation of dirt and liquids.
2. Drainage to trap directed by vertical cast-in slots.
3. Continuous, fully automatic trap action.
4. Rapid diffusion and filtration through permanent, cleanable Poro-Stone.
5. Clean, dry air at practically unchanged pressure. Standard, stocked sizes handle from 10 to 700 cfm.

Easily installed in either vertical or horizontal pipe line.


THERMOMETER TO INDICATE DISCHARGE AIR TEMPERATURE
WATER OUTLET
AIR INLET
AIR OUTLET
WATER INLET
INNER CYCLONE VORTEX
TRAP VENT CONNECTION
WATER LEVEL INDICATOR
TRAP CONNECTION
SCALE TRAP & CLEANOUT

**AFTERCOOLER AND CYCLONE SEPARATOR*

Cools air to within a few degrees of cooling water, making certain that compressed air is colder than surrounding atmosphere, so that no further condensation can take place.

Counter flow, air-through-tube design assures continuously high heat transfer rate.

Double cyclonic action deposits all water and entrained oil in moisture chamber.

R. P. ADAMS CO., INC.
209 E. Park Drive, Buffalo 17, New York

Please send me your latest literature, Bulletin No. 176 on BOTH the Poro-Stone air filter and the Adams Aftercooler — Cyclone Separator.

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Company.......... *Title*..........
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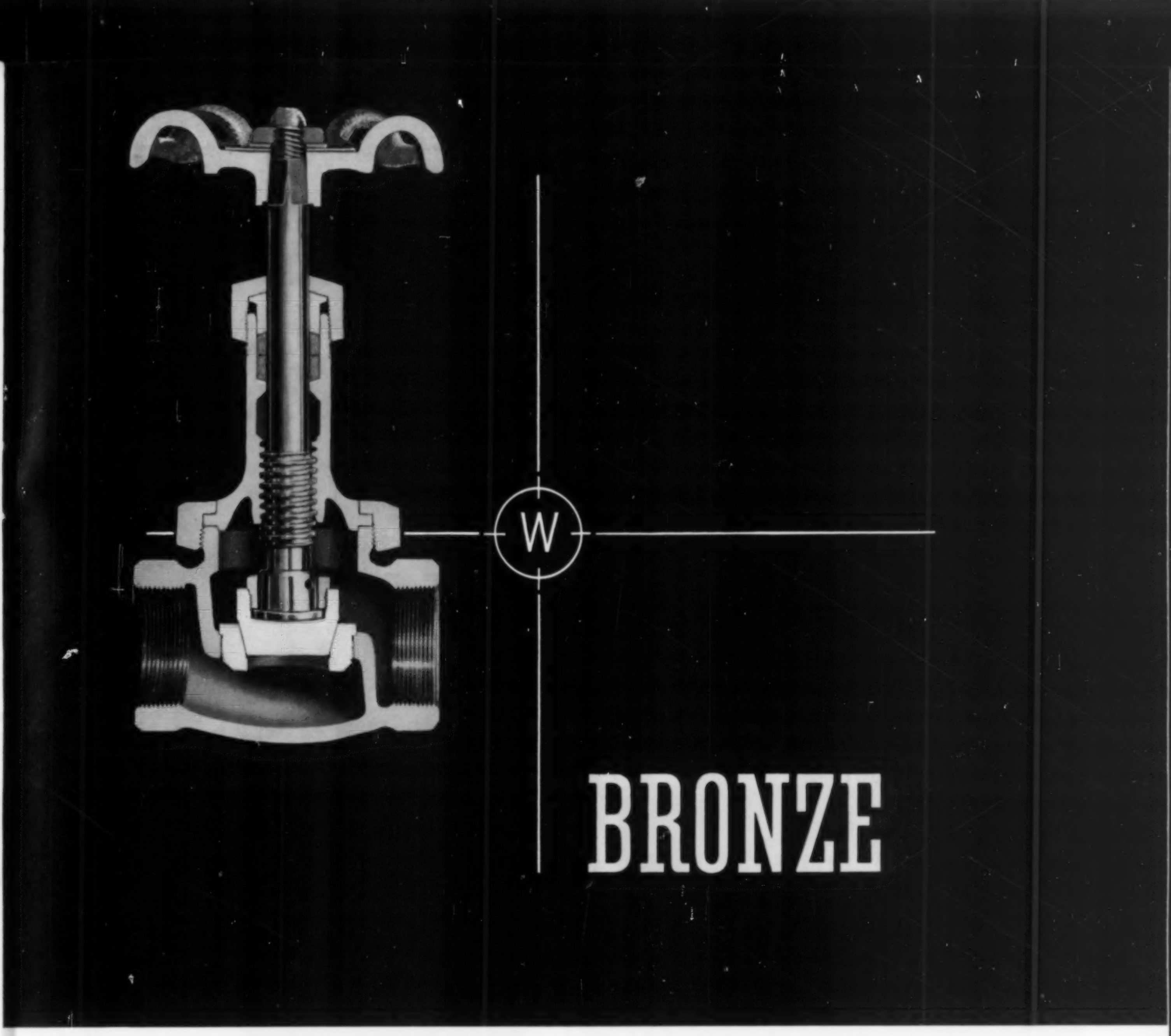
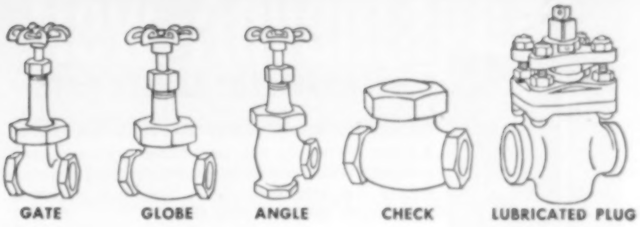
COOL
DRY
Air
TOOLS

FOR YOUR PROFIT'S SAKE
— FIND OUT ABOUT BOTH

R. P. ADAMS CO., INC., BUFFALO 17, N. Y.





COMPLETE LINES OF BRONZE VALVES AND PIPE FITTINGS are manufactured by Walworth in a variety of types, pressure ratings, sizes, and patterns, including Walseal® Bronze Valves and Fittings for making Silbraz® joints.

Walworth also manufactures complete lines of valves and fittings – including Lubricated Plug Valves – made of steel, iron, and special alloys as well as bronze.

Walworth-made valves, pipe fittings, and pipe wrenches, total approximately 50,000 items–all sold through distributors in principal centers throughout the world.

Walworth engineers will be glad to help you with your problems. For full information call your local Walworth distributor, nearest Walworth sales office, or write to Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

Bronze valves in gate, globe, angle, check, and lubricated plug types are manufactured by Walworth. Illustrated is a sectional view of a Walworth No. 225P Bronze Globe Valve. This valve has a working steam pressure rating of 350 psi at 550F (1,000 psi non-shock cold water, oil, and gas pressure). It features a renewable, plug type, stainless steel seat and disc, heat treated to 500 Brinell hardness.

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valves . . . pipe fittings . . . pipe wrenches

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Quality CLOTHING AND BOOTS... *Made to Give Full Protection... Real Comfort... Long Wear*

The assured quality of Goodall work clothing and footwear, in design, materials and craftsmanship, means complete **protection with comfort** on any type of job, and a lot of extra wear before replacement, regardless of rough use.

COATS · JACKETS · OVERALLS

A wide selection of styles, in rubber, oiled and latex-coated . . . for reliable wet-work and wet-weather protection above ground or below. Every garment made to specifications that assure long, economical wear, with maximum comfort. Reinforced where extra strength is required without impairing complete freedom of movement. Style 338 Coat is the Contractor's favorite. Style 80 Jacket with Style 81 Overall makes the ideal shaft unit.

"TOE-SAVER" ® BOOTS

First-quality black rubber boots with features that provide the ultimate in durability, comfort and safety. The famous "Toe-Saver" Safety Toe Cap withstands 2,000 lbs. pressure per square inch. Made with white bumper tip for positive identification. Short, three-quarter and full hip lengths. Slip-resistant Grid Tread soles.

Other Goodall Footwear includes "Wear King" Boots—same quality as "Toe-Saver", but without Safety Toe feature. Regular, top-Lace and Terra Haute Pacs. Work shoes, artics and rubbers.

"HARDBOILED" SAFETY HATS

GLASS "HARDBOILED" SAFETY HATS . . . Easiest to wear, yet providing greatest head protection. Exceed highest established requirements for strength; heat, fire and moisture resistance; and dielectric tests.

Contact our nearest branch for samples and prices of the items mentioned above or any other articles of clothing and footwear you may need. Years of acceptance of these Goodall products by the construction, mining and other industries is your assurance of dependable value and economy.

Contact Our Nearest Branch for Prices

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GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

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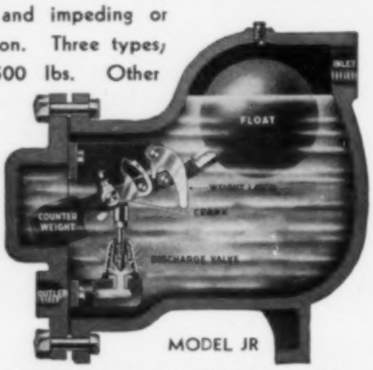
New NICHOLSON NON-PLUG AIR TRAPS

Introduce Oil-Eliminating Feature Preventing Build-up of Scum and Sludge

In these Nicholson air traps you enjoy the advantages of the positive intermittent action of a float-operated air trap without the common problem of oil congealing on the mechanism and impeding or stopping its action. Three types; pressures to 1500 lbs. Other features: No air - wasting vent. Positive water seal at valve. Large orifice keeps valve clean. For details send for . . .

Bulletin 651



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Please send me:

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- ☐ Compressed Air Data and Cameron Pump Operators' Data Both books for $4.50.
- ☐ Enclosed is (money order) (check) for $........) ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

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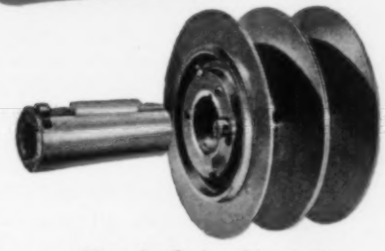
City .... State .... County ....

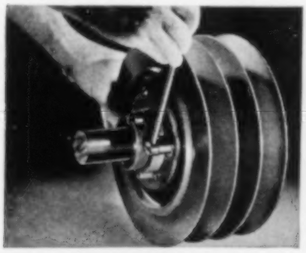
TEXROPE

Greatest Name in V-Belt Drives



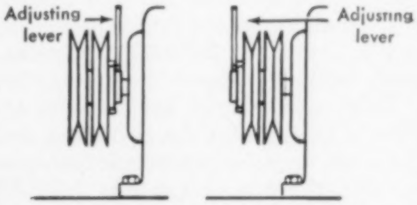
1 Magic-Grip Mounting

The widely used *Magic-Grip* tapered bushing is now supplied with the Wide Range *Vari-Pitch* sheave, making it the fastest mounting sheave of its type on the market. Turning only one screw makes or breaks the vise-like grip of sheave bushing on motor shaft.



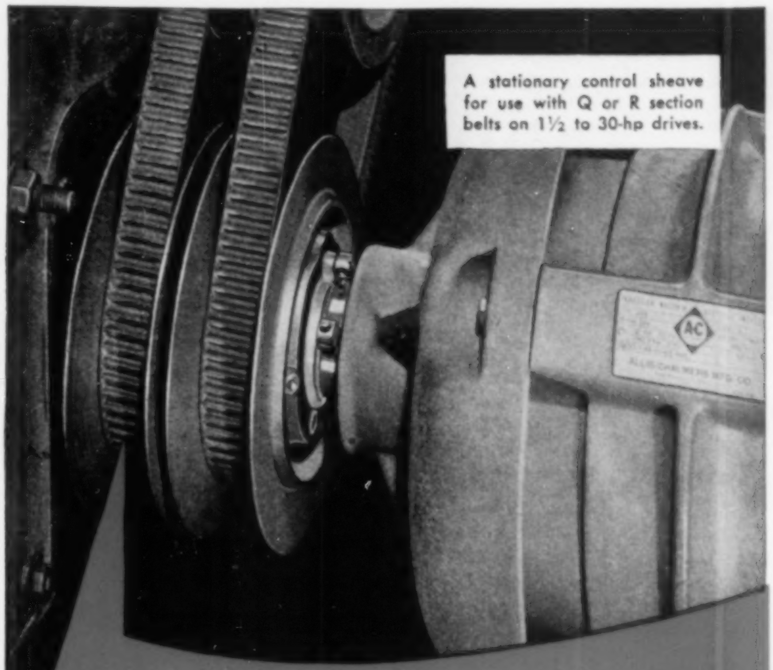
2 Fast Adjustment

To change sheave diameter — thereby changing speed — simply turn a single adjusting screw, *using a lever rod* that slips through a hole in the head of the screw. No more fumbling with screw drivers. Adjustment is fast and accurate.



3 Adjusts From Either Side

Sheave can be mounted on motor shaft so adjusting screw is either toward or away from motor bearing, as indicated above. This feature is especially important in installations where space for adjustment is limited. It's the only sheave of its type with this feature.



A stationary control sheave for use with Q or R section belts on 1½ to 30-hp drives.

NOW!

Wide Range Vari-Pitch Sheave has 3 New Advantages

GET COMPLETE DATA FROM YOUR NEARBY ALLIS-CHALMERS DISTRIBUTOR OR DISTRICT OFFICE, OR SEND COUPON.

ALLIS-CHALMERS
MILWAUKEE 1, WIS.

Send me complete specifications and engineering data on the new Wide Range *Vari-Pitch* sheave . . . 20S7811.

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Texrope, Vari-Pitch and Magic-Grip are Allis-Chalmers trademarks.

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COMPRESSED AIR AND GAS COME OUT OF THE LOGAN

ARIDIFIER

Scrubbed CLEAN AND DRY

INSTALL ARIDIFIERS ON LINES SERVING

- Paint Spray Guns
- Air Tools
- Air Hoists
- Foundry Jogging Machines
- Sand Blasting Tools
- Sand Blasting Rooms
- Metal Spray Guns . . . or Wherever the line must deliver clean, dry air or gas

On any air or gas line 92% of the dirt, oil, scale and water that enter the Aridifier is trapped and removed from circulation. The Aridifier's patented centrifugal-baffle action scrubs air and gas clean and dry . . . protects equipment, prevents freezing, fouling, corrosion and caking, produces best results with spray gun and air tool operations, etc. Easy to install. Self cleaning. Maintains itself. 10 models available. Capacity 7 CFM to 17,000 CFM.

Learn HOW the Aridifier scrubs with a patented centrifugal-baffle action.

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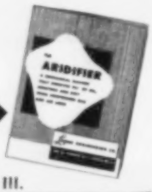
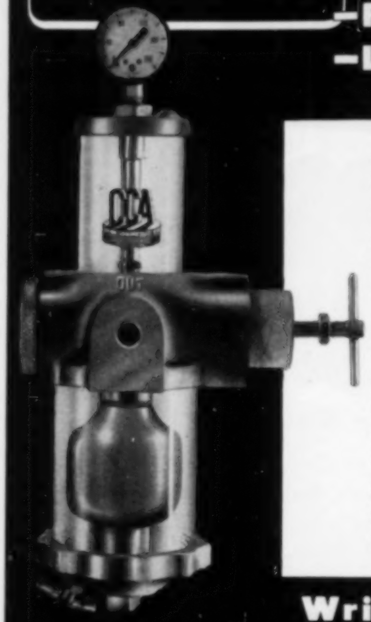
Now!



Logan ENGINEERING CO.
4915 W. Lawrence Ave., Chicago 30, Ill.

AMERICA'S MOST COMPACT

MULTI-PURPOSE—REGULATOR —FILTER —LUBRICATOR



A design and engineering triumph... regulates pressure, filters, disperses precisely the correct amount of atomized oil, indicates operating pressure, controls surges within 2 lbs. and serves as a shut off valve. Made in pipe sizes from ¼" to ¾", RFL can be installed in an airline with two simple pipe connections. Most models shipped from stock.

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CCA Products Division

BRECO MANUFACTURING COMPANY
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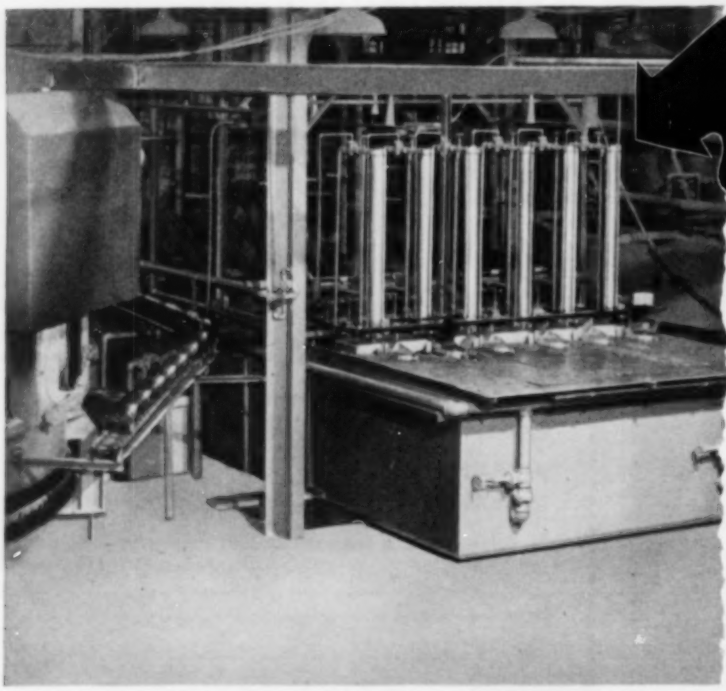
Dealer franchises available in certain territories. Write or wire Sales Manager.



View of Heat Treating Department, at Gas Machinery Company, shows NOPAK Cylinders which dip baskets of parts into quenching tanks.

Quench Dipping with NOPAK Cylinders

Expedites Heat Treating Cycle

At the Gas Machinery Company, Cleveland, Ohio, work-pieces are conveyed from the heat treating furnaces into wire baskets which are then immersed into a quenching bath by a series of NOPAK Cylinders mounted vertically above the quenching tank. After quenching, the baskets are lifted out of the tank by the cylinders, and the parts are transferred to another conveyor, with the aid of another NOPAK Cylinder, for further processing.

This installation is typical of the many materials-handling operations in which NOPAK Valves and Cylinders are used. For others see the NOPAK Application Manual.

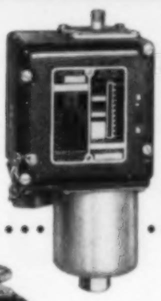
GALLAND-HENNING MANUFACTURING CO.
2759 SOUTH 31ST STREET MILWAUKEE 46, WISCONSIN

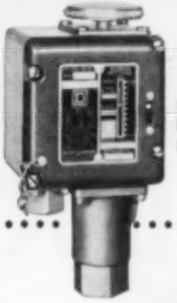
Refer to Sweets File for Product Designers or write for Bulletin SW-1

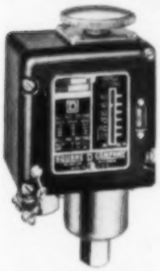
Representatives in Principal Cities

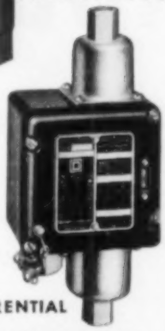
NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

SQUARE D
for a COMPLETE LINE of
INDUSTRIAL PRESSURE SWITCHES









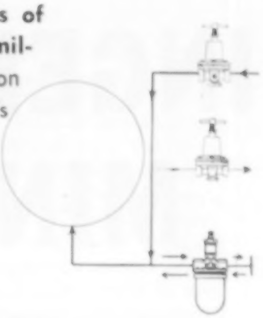
Write for Bulletin 9012
Square D Company
4041 North Richards Street
Milwaukee 12, Wisconsin

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

how **NORGREN** lubricates air cylinder with less than 1 cfm air flow

The Niles Tool Works of the Baldwin-Lima-Hamilton Corp., in cooperation with, Norgren, developed this setup to build up a "negligible" flow of air to a flow rate adequate to give efficient lubrication of air cylinder.

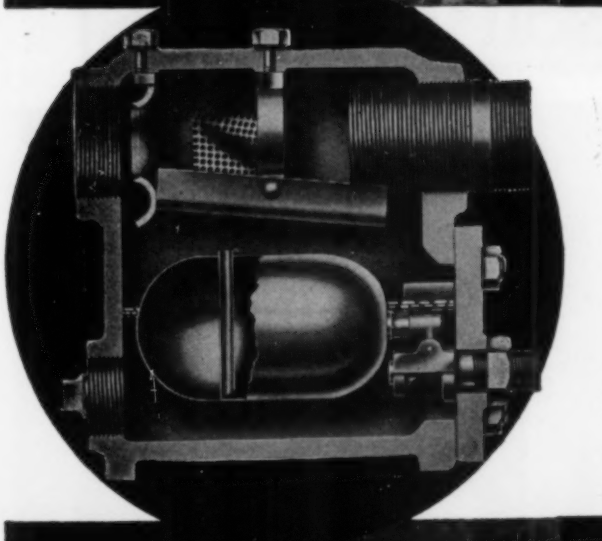


WRITE, NOW, FOR DETAILS IN NORGREN BLUEPRINT NO. 117

Norgren®
C. A. NORGREN CO.
3407 So. Elati St., Englewood (suburb of Denver)
IN COLORFUL COLORADO

DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH

DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

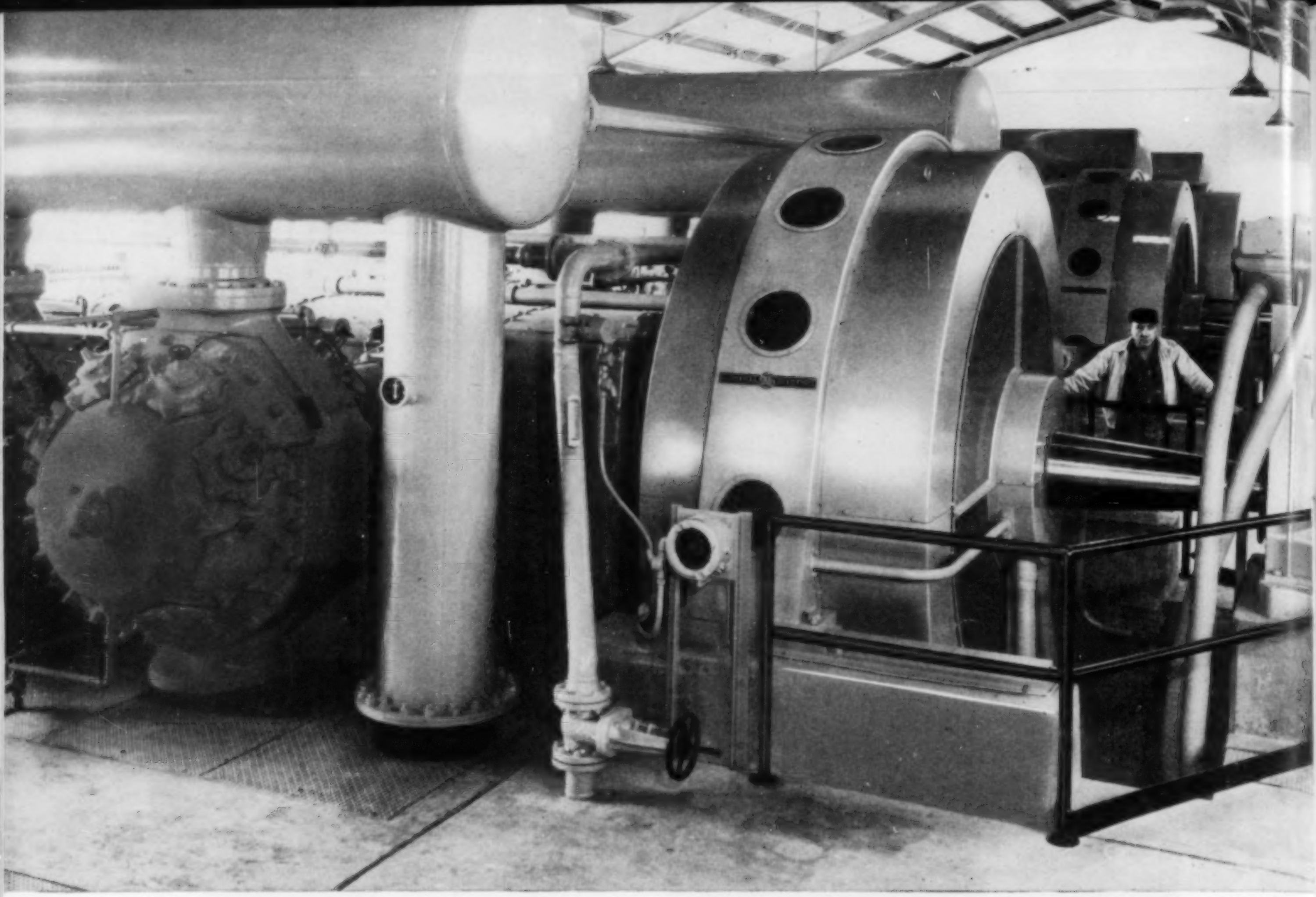
WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

NEW JERSEY METER CO.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

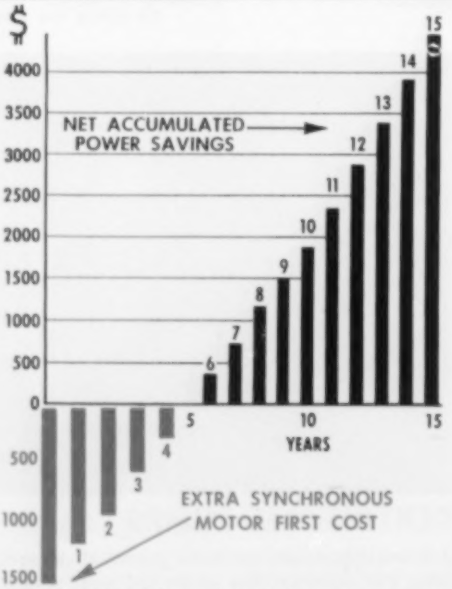
vers every
The two-
r scraping
m the face.

omy and dependability under the most severe conditions of mine service. Each of the four-stage, 500 hp units shown handle 800 gpm at 1700 ft head in a centralized drainage system for a group of copper mines.



COMPRESSORS IN A GAS STORAGE STATION are driven by General Electric 3000 hp, 300 rpm synchronous motors.

Can synchronous motors cut

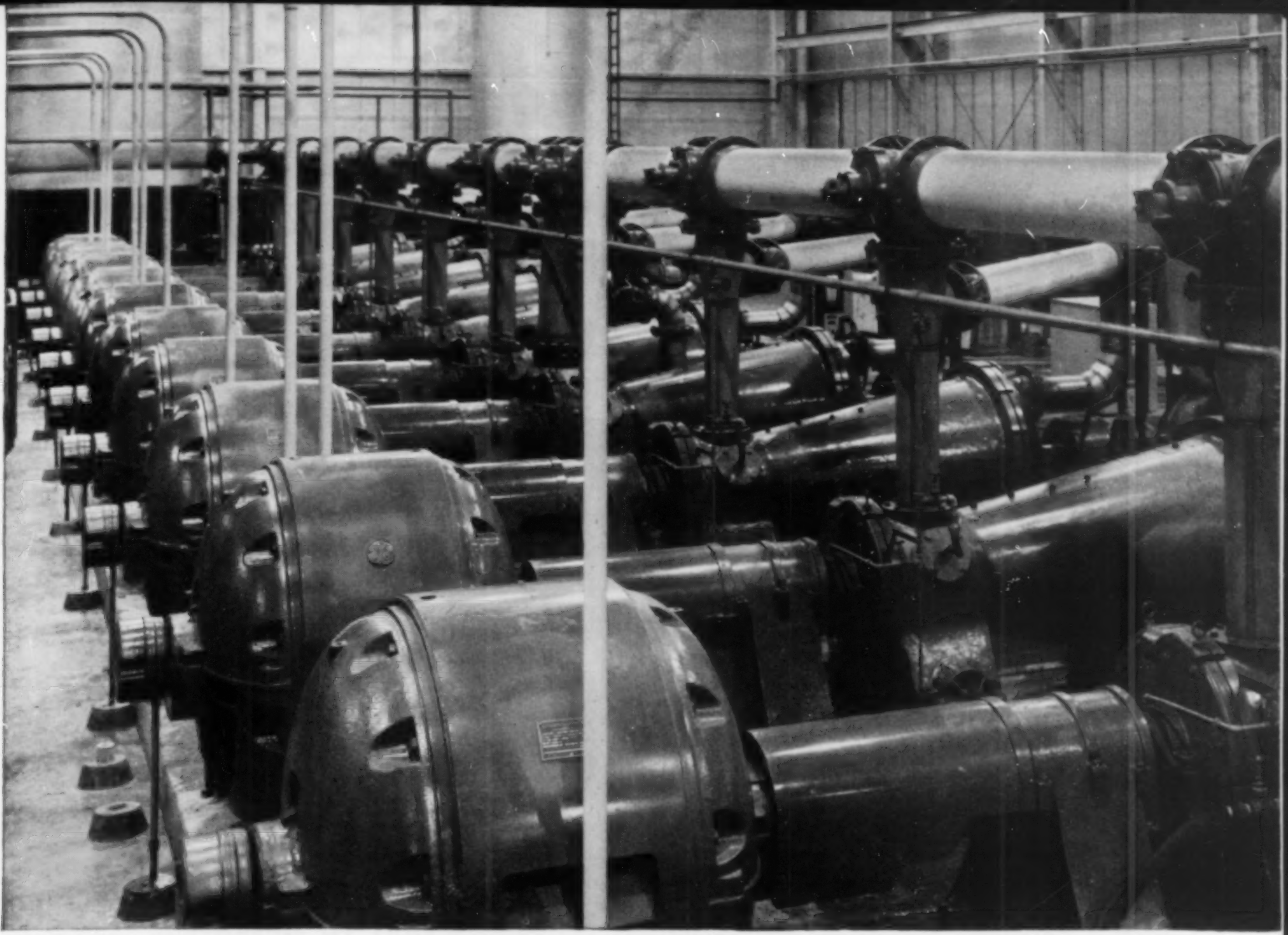


OPERATING SAVINGS on the synchronous motor application described above are shown over a period of twenty years. Extra first cost will be amortized in five years; savings will continue for many more.

Here's how one plant saves with a G-E Synchronous Motor

The specifications for a new pump motor were 250 hp, 600 rpm, 2300 volts, 3 phase, 60 cycle. The price of a 1.0 Power Factor synchronous motor, including exciter and control, was higher than an equivalent squirrel-cage induction motor with control. However, the synchronous motor efficiency, including exciter loss, was 1.6% higher than the induction motor (93.0% vs 91.4%). Since the motor was to operate continuously at a power cost of 11 mils per kilowatt-hour, it was found that the power savings would repay the additional investment in only five years. The operating savings will continue throughout the life of the motor—10, 20, even 30 years.

Savings such as these make synchronous motors the most economical drive for many heavy-duty, continuous-service applications. And in many cases, synchronous motors are lowest in first cost, too.



GENERAL ELECTRIC 400 HP SYNCHRONOUS MOTORS are coupled to ten Jordans in a paper mill.

your plant's operating costs?

Greater Efficiency on Large, Constant-Speed Applications Can Lower Power Costs Substantially

On certain applications selection of General Electric synchronous motors can bring about substantial savings in plant operating costs. Synchronous motors usually have a higher full-load efficiency than any other type of motor, produce more work per dollar's worth of power consumed.

Furthermore, synchronous motors may be able to improve plant power factor—the ratio of total kilowatt load to total kva load. When these two fall out of balance, high system losses, high power bills, or increased maintenance costs commonly result. Using a *unity power factor* synchronous motor adds only to total kw load. And, a *leading power factor* synchronous motor will actually supply reactive kva's to your system, while operating at its normal rated output.

Before you select a drive for a large piece of equipment providing heavy and continuous service, be sure to investigate the economics of General Electric synchronous motors. Call in your G-E representative—he'll be glad to discuss your situation with you. Also, information on G-E synchronous motors and their application is available in the following bulletins: GEA-5332, "Low-Speed Synchronous Motors;" GEA-5426, "High-Speed Synchronous Motors;" GEA-5817, "Plant Power Factor Improved With G-E Synchronous Motors." Write to Section 770-27, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

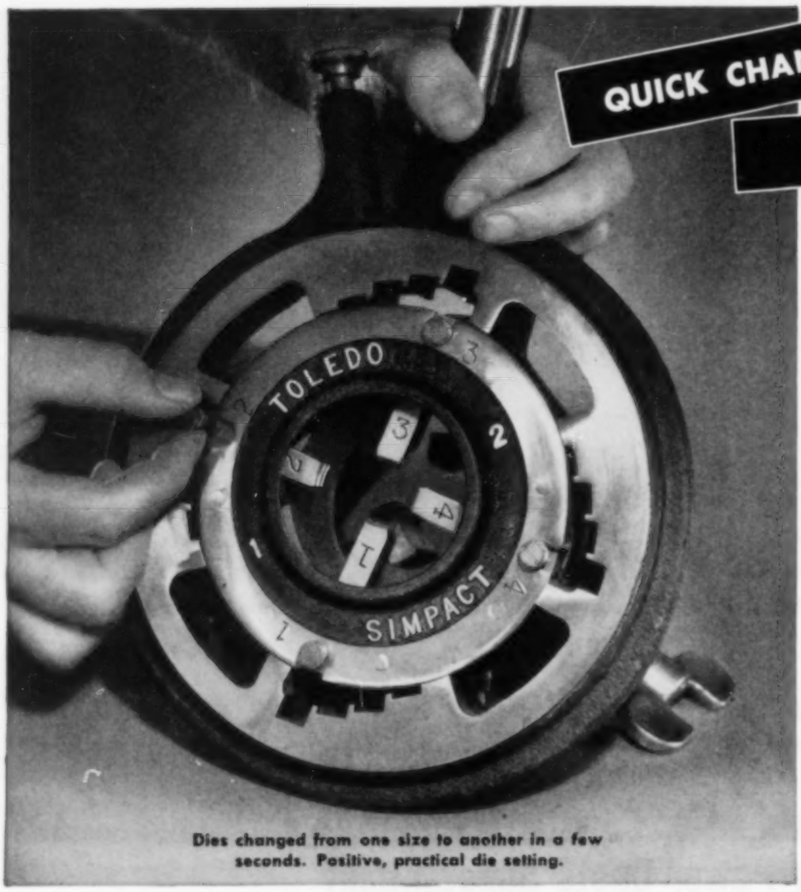
SAVE TIME TWO WAYS

with TOLEDO SIMPACT

for all 1" to 2" threading!

QUICK CHANGE TO 4 PIPE SIZES

QUICK THREADING



Dies changed from one size to another in a few seconds. Positive, practical die setting.

ONLY ONE SET OF DIES for 4 pipe sizes.

FASTER CHANGE OF SIZES! Just push the size selector button, slip dies in proper steps, turn head slightly and die size is changed!

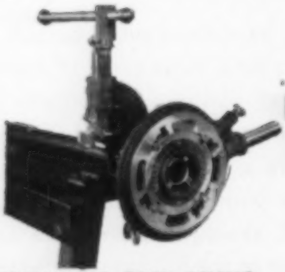
EXTRA RUGGED FOR EXTRA LONG LIFE... producing accurate threads.

EASY TO OPERATE . . . simple in design . . . fewer parts . . . light in weight.

AMAZINGLY COMPACT . . . will thread a pipe projecting through a wall as short as 6¼".

ACCURACY THROUGH THE YEARS . . . dies recede along tapered steps . . . no cams to wear.

LOW COST! This remarkable self-contained tool assures smooth, perfectly tapered, leak-proof threads at lower cost! Play safe! Buy Toledo Simpacts at your dealer. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

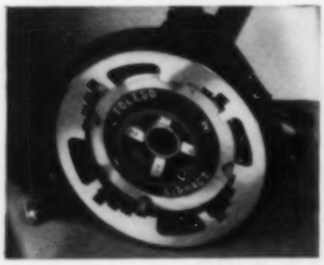


50 YEARS OF LEADERSHIP

TOLEDO

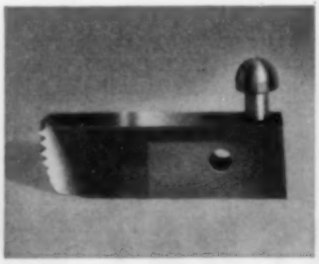
PIPE TOOLS . . . POWER DRIVES . . . POWER PIPE MACHINES

AUTOMATIC DRIP OILING. Oil pockets in head of a Simpact collect oil and drip directly on dies.



3-CHUCK JAWS. Simpact pipe holder with 3-chuck jaws is easy to center, and assures perfect aligned threads.

TOLEDO SIMPACT DIES are made of high speed steel and are easily resharpened.



SIMPLE . . . COMPACT. Note the simplicity of the Simpact. No complicated cam parts to clog with dirt and wear.

teamwork
in
specialties

THE BLASTER

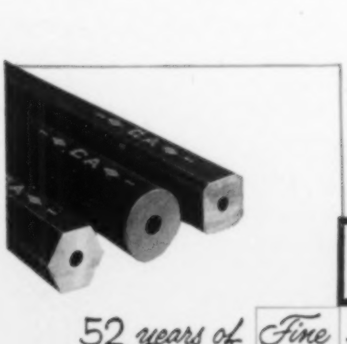
CRUCIBLE HOLLOW
DRILL RODS

In rock-drilling operations, the blaster is a key man. He plans the blast, tells the drill-runners where to drill their holes, loads the charge for the greatest effectiveness.

He expects . . . and gets . . . peak efficiency from his men and the tools they use.

This is why Crucible Hollow Drill Rods rank first with crews supervised by top-notch blasters. Experience has shown them that Crucible rods stand the rapid-fire battering of modern rock-drilling longer; give them the least breakage, the greatest service life.

Crucible Hollow Drill Rods are right for the job because they are made by the world's largest producer of *tool and high speed steels.* From this metallurgical experience come the high mechanical properties that have set record after record for least cost per foot drilled. Use Crucible Hollow Drill Rods in all your drilling operations.



CRUCIBLE first name in special purpose steels

52 *years of Fine steelmaking*

HOLLOW DRILL RODS

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

REX HIGH SPEED • TOOL • REZISTAL STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

CLEAN, THRIFTY COMPRESSORS under ALL conditions

. . . assured with the proper Texaco air compressor oil

So many different conditions may affect air compressor operation that no one oil can properly handle all of them. For that reason Texaco offers an air compressor oil for every operating condition. Use the one suited to *your* conditions and you can count on improved compressor performance and lower maintenance costs. Here are a few examples:

1. To eliminate conditions causing rust in cylinders, intercoolers, lines or receivers, a Texaco *rust-inhibited* air compressor oil is recommended.
2. To overcome "wet cylinder" conditions where the washing effect causes excessive wear, a Texaco *compounded* air compressor oil is recommended.
3. To assure clean operation and minimum wear under normal conditions, a Texaco *straight mineral* oil is recommended.

Let a Texaco Lubrication Engineer help you select the Texaco air compressor oil best suited for your operating conditions. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

TEXACO Air Compressor Oils
FOR ALL OPERATING CONDITIONS

Faithfully yours
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TEXACO
for Fifty Years

TUNE IN: Tuesday nights on television—the TEXACO STAR THEATER starring MILTON BERLE. See newspaper for time and station.